ENGINEERING AND MINING JOURNAL

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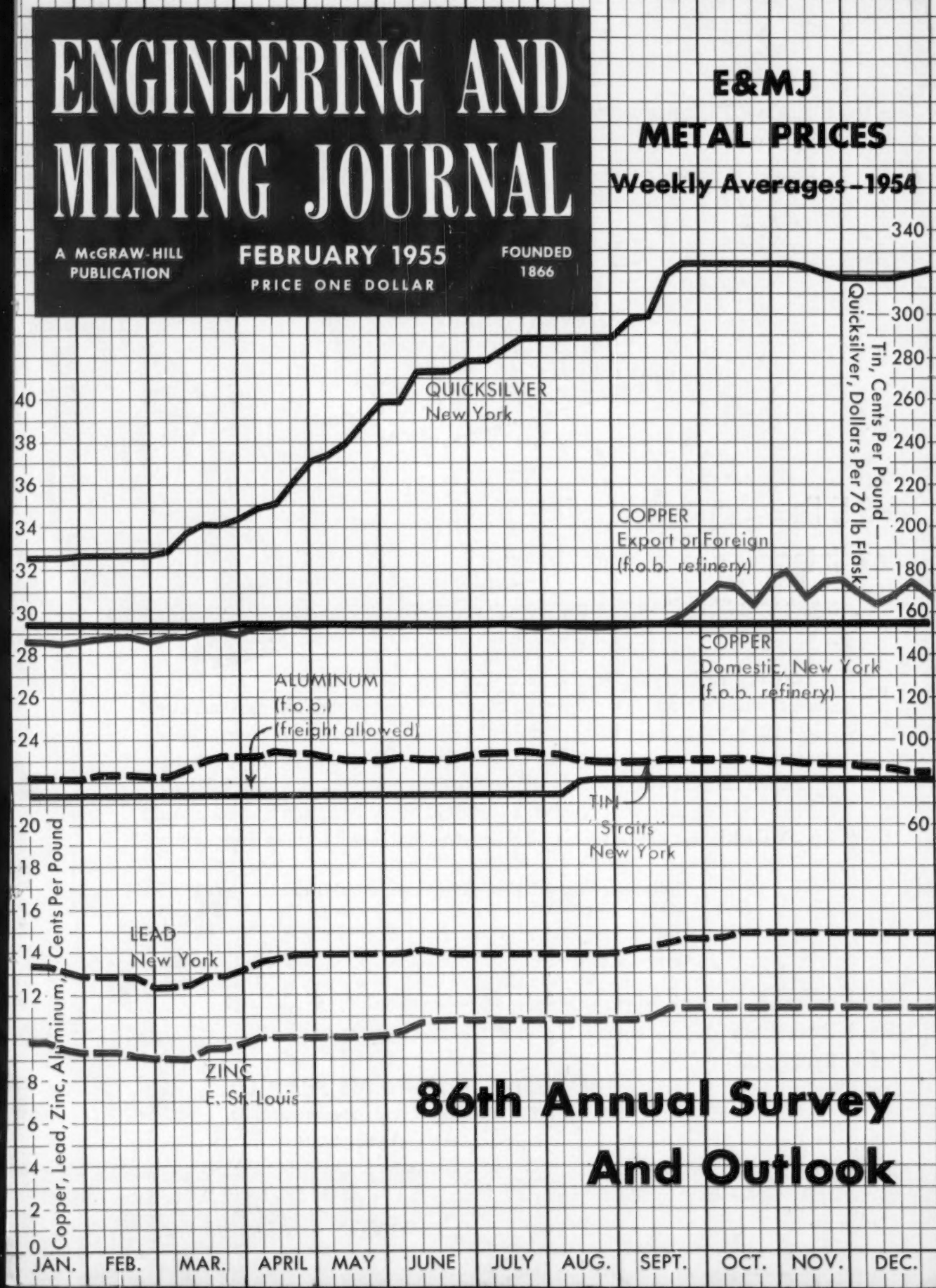


86th Annual Survey And Outlook

Which slurry pump is the

HYDROSEAL
CENTRISEAL
?

A-S-H lines of complementary pumps now integrated in five identical sizes

. . . ranging from 2" to 8" suction and discharge

To slurry-moving operations that can take advantage of the mechanical efficiency inherent in the Hydroseal Pump, yet in part must deliver pulp undiluted by sealing water, these interchangeable Hydroseal and Centriseal Slurry Pumps mean a new era in pumping technique and economy. Otherwise identical, only two parts are different – the Maximix Rubber impeller and engine-side shell half-liner. When operating purposes call for it, a Hydroseal Slurry Pump can be transformed into a Centriseal, and vice versa, with little more effort than it takes to change a tire.

Hydroseals, due to their gland-sealing feature, maintain their initial high efficiency up to the point Maximix Rubber replacements are needed. They save ⅓ to ½ in power costs, since over-size pump & motor allowance for wear is never required.

Centriseals are industrially efficient in moving abrasives, corrosives and acids where pulp must be delivered undiluted. As with Hydroseals, the moulded-to-shape Maximix Rubber parts are locked into position mechanically—no vulcanizing!

Let us advise you in detail. Write us about your problem.

In addition...

there is the complete line of HYDROSEAL Sand & Dredge Pumps

THE ALLEN-SHERMAN-HOFF PUMP CO.
Dept. B—259 E. Lancaster Ave., Wynnewood, Pa.

Representatives throughout the World

HYDROSEAL *and* CENTRISEAL
SAND, SLURRY & DREDGE PUMPS

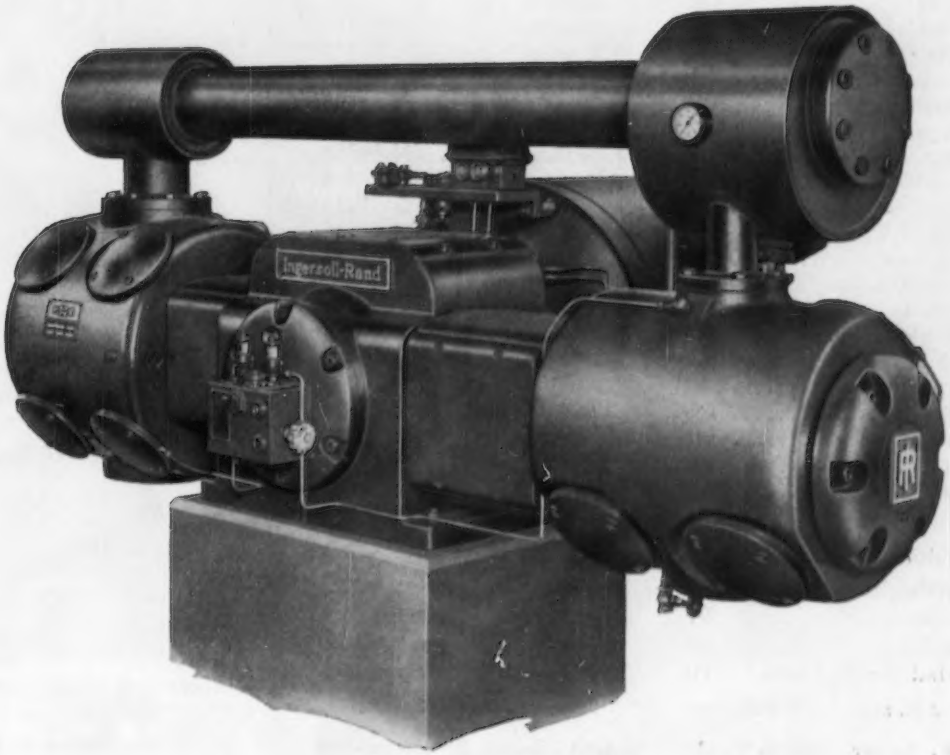
MAXIMIX RUBBER PROTECTED

NEW

OPPOSED-CYLINDER

BALANCED DESIGN, TYPE PHE

COMPRESSOR



COMPACT, SPACE-SAVING PACKAGED DESIGN

The new, space-saving PHE design marks another Ingersoll-Rand achievement in electric-driven compressors. Built for continuous, heavy-duty service, it includes the following outstanding features: Opposed pistons with excellent running balance — Efficient tube-type intercooler—New cylinders with Type A Channel Valves—Motor mounted directly on crankshaft—Full floating aluminum main and crank-pin bearings — Sealed crankcase — Force-feed lubrication.

FOR EASY SHIPMENT, INSTALLATION & RELOCATION

Shipped completely assembled and ready to run, the PHE compressor can be easily installed—in very little floor space—with a minimum of piping—and on a simple inexpensive foundation. Relocation, if required, is equally simple.

ELECTRIC-DRIVEN 75 AND 100 HP SIZES

The basic design is a two-stage unit for 80-125 psi. For other pressures, or for pumping vacuums, alternate cylinder arrangements can be supplied. It will pay you to get all the facts on this new, cost-saving design. Ask for Bulletin No. 3155.

Ingersoll-Rand

1-106 11 Broadway, New York 4, N. Y.

COMPRESSORS • AIR TOOLS • ROCK DRILLS • TURBO BLOWERS • CONDENSERS • CENTRIFUGAL PUMPS • DIESEL AND GAS ENGINES

ENGINEERING AND MINING JOURNAL

89th YEAR OF PUBLICATION

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LETTERS

One Alone

Please send me another copy of U_3O_8—Formula for Profits (*E&MJ*, September 1954). . . . Edition was so interesting that I was carrying it about with me and lost it. I especially desire a copy for my file, complete for 20 yr.

R. N. Pulliam
Alpine, Tex.

I was much impressed (with U_3O_8 issue) . . . excellent coverage and well done.

George L. Robb
Golden, Colo.

Too technical. Didn't understand a word of it.

Hardrock Miner

Please rush (reprints). Planning a uranium venture and find (it) best source available.

George N. Clawson
Fort Worth, Tex.

Dandy U_3O_8 writeup. I want (another copy) badly. . . . Could you please dig one up somewhere?

Charles E. Roberts
Blythe, Calif.

Our institution works in coordination with the U.S. AEC and is in charge of exploration and mining uranium in Peru. Your September issue . . . is of utmost importance to us.

Jorge Sarmiento C.
Junta de Control de Sustancias Radioactivas
Lima, Peru

I figured I would have to go to the library and copy the uranium article out of the September issue. Thanks for the reprints.

James H. Stewart
Asheville, N.C.

• *Reprint sales are now near the 15,000 mark.—Ed.*

The Value of K

I refer . . . to the interesting article by Sieger and Fink on "Extracting Zinc from Concentrates by Chlorination" (*E&MJ*, October 1954, p 90).

Some reference . . . should have been made to a somewhat similar set of experiments described by C. G. Maier in the Jan. 13, 1923 issue of *E&MJ*.

Maier showed that moist chlorine gave more selectivity in chlorination, in that only about one-third as much Fe_2O_3 and Al_2O_3 was chlorinated with wet chlorine as with dry.

There must be a typographical error in the value of K given by Sieger and Fink for the reaction:

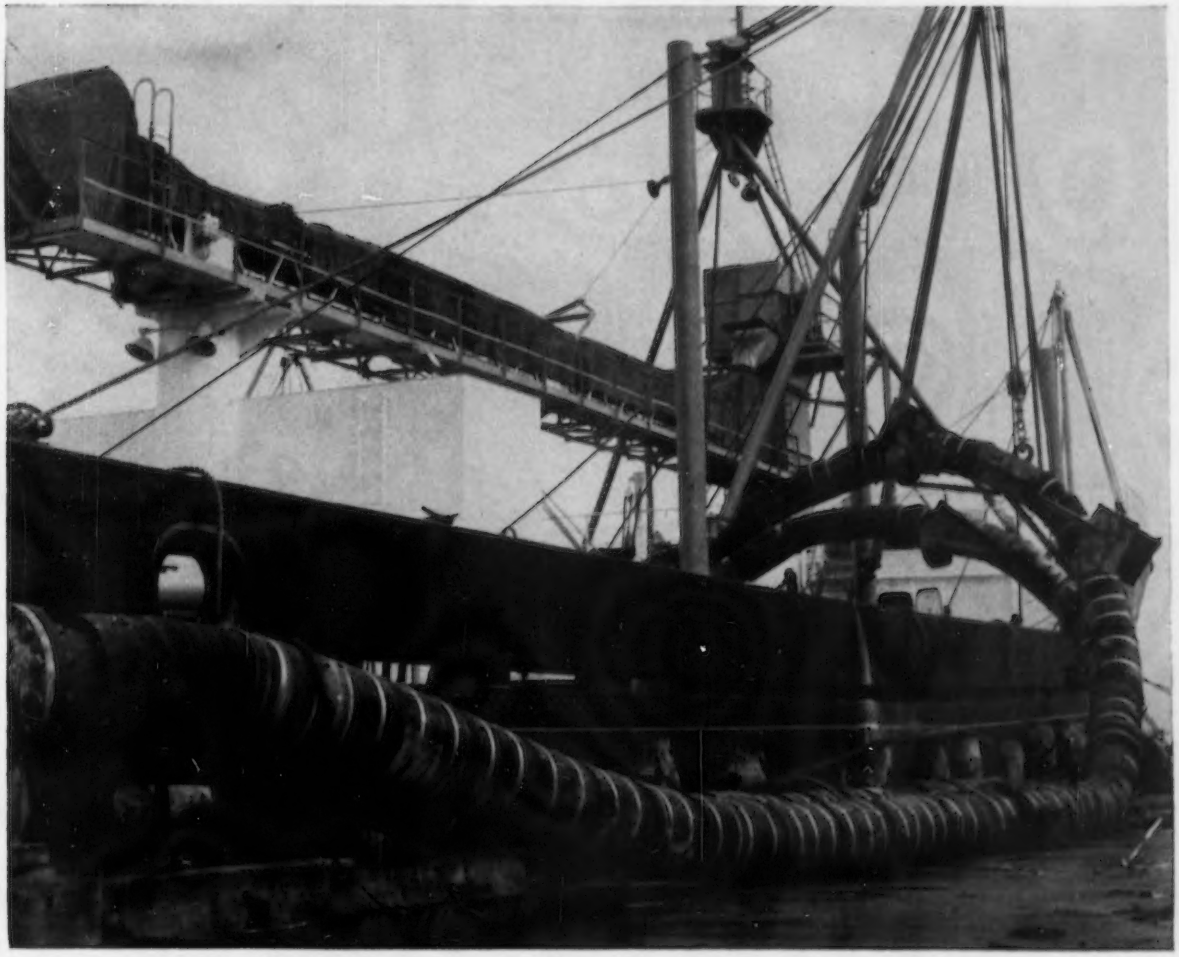
$$PbO - Cl_2 = PbCl_2 - \tfrac{1}{2}O_2$$

My calculations indicate that K should be about 8×10^4 rather than the 7×10^{-11} shown.

A. W. Schlechten,
Rolla, Missouri

• *Prof. Schlechten is right. However, the authors' figure for the value was not 8×10^4, but 1×10^4.—Ed.*

RESEARCH KEEPS **B.F.Goodrich** FIRST IN RUBBER



There goes a turnpike in the rough

A typical example of B. F. Goodrich improvement in rubber

IT'S down the hatch—20 barrels a minute—as dry cement whistles through that hose and pours into the ship's hold.

A wonderful idea—pumping cement through hose—much faster, far cheaper than individual sacks that had to be carried on and off the ship. Only one trouble.

Turn off the pump, and the hose would collapse, putting permanent dents in the coil of solid steel wire buried in the rubber. B. F. Goodrich engineers went to work on the problem, and came up with a new hose design. They put a spiral of flexible steel cable in the hose body. That makes the hose flexible as well as strong, so it always returns to full round shape under pressure.

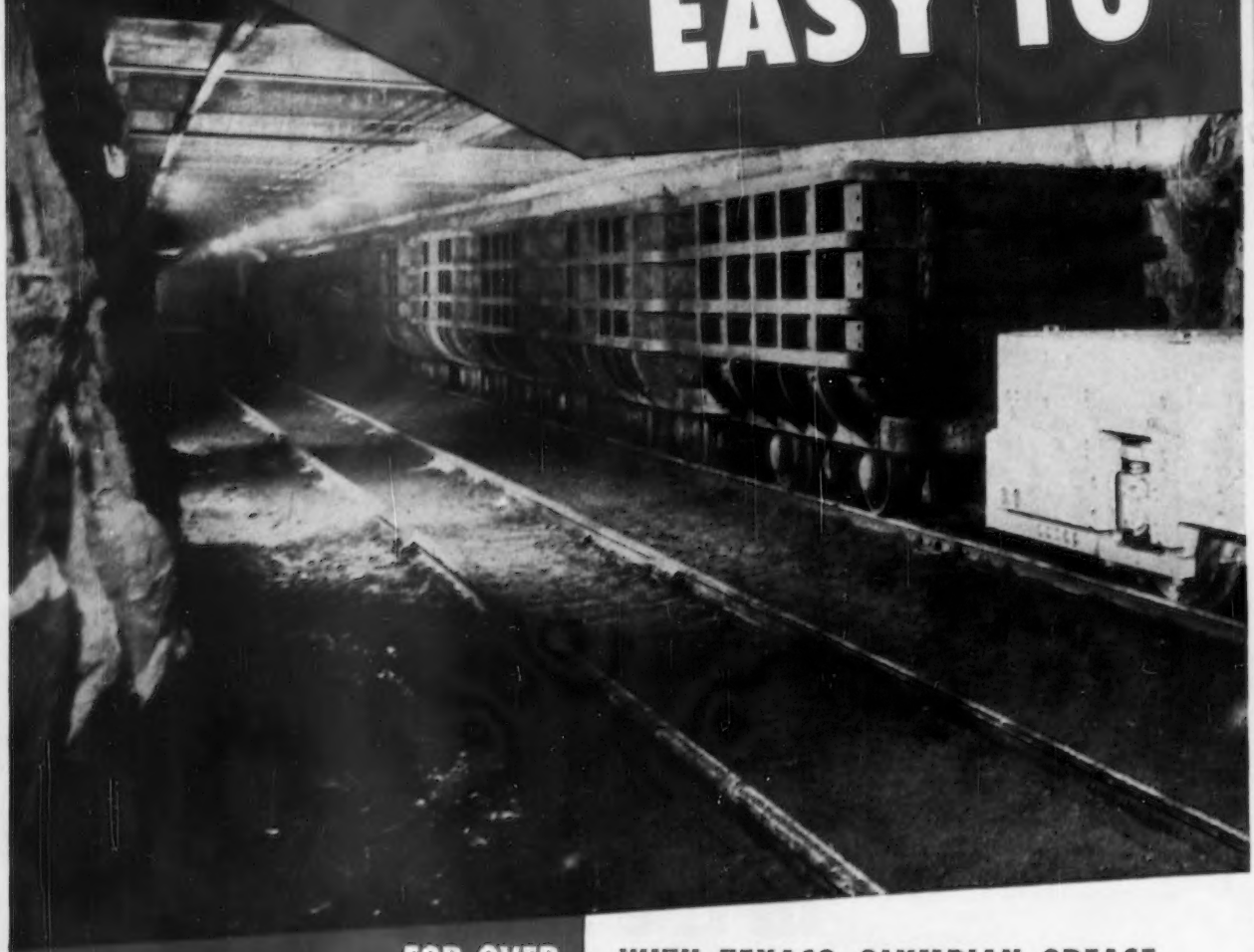
The B. F. Goodrich hose was tried, and works perfectly. It has carried more than 1½-million barrels of cement—enough to pave a 100-mile stretch of turnpike—and shows no sign of wearing out.

Product improvement is *always* going on at B. F. Goodrich. Some improvements are big, spectacular; some are little; many are too technical to explain easily, but all save you money. If you use hose, belting or other rubber products, remember B. F. Goodrich is one company that will *never* lower its quality standards. This means you can be sure of top performance and real money savings.

To get this extra value, these lower costs year after year, call your B. F. Goodrich distributor. Find out about the latest improvements or try out the latest and best types of any rubber products you buy. *The B. F. Goodrich Company, Dept. M-372, Akron 18, Ohio*

B.F.Goodrich
INDUSTRIAL PRODUCTS DIVISION

EASY TO START EASY TO



FOR OVER 20 YEARS, MORE COPPER ORE HAS BEEN MINED IN THE U.S. WITH TEXACO-LUBRICATED EQUIPMENT THAN WITH ANY OTHER

WITH TEXACO OLYMPIAN GREASE, mine cars operate smoothly and dependably throughout the year. Even in coldest weather, cars start easily so that locomotives can haul longer trains, move more tonnage per shift.

You'll find that maintenance savings are easy to make, too. That's because *Texaco Olympian Grease*

TUNE IN...TEXACO STAR THEATER starring JIMMY DURANTE or DONALD O'CONNOR on TV Saturday nights. METROPOLITAN OPERA radio broadcasts Saturday afternoons.

TEXACO

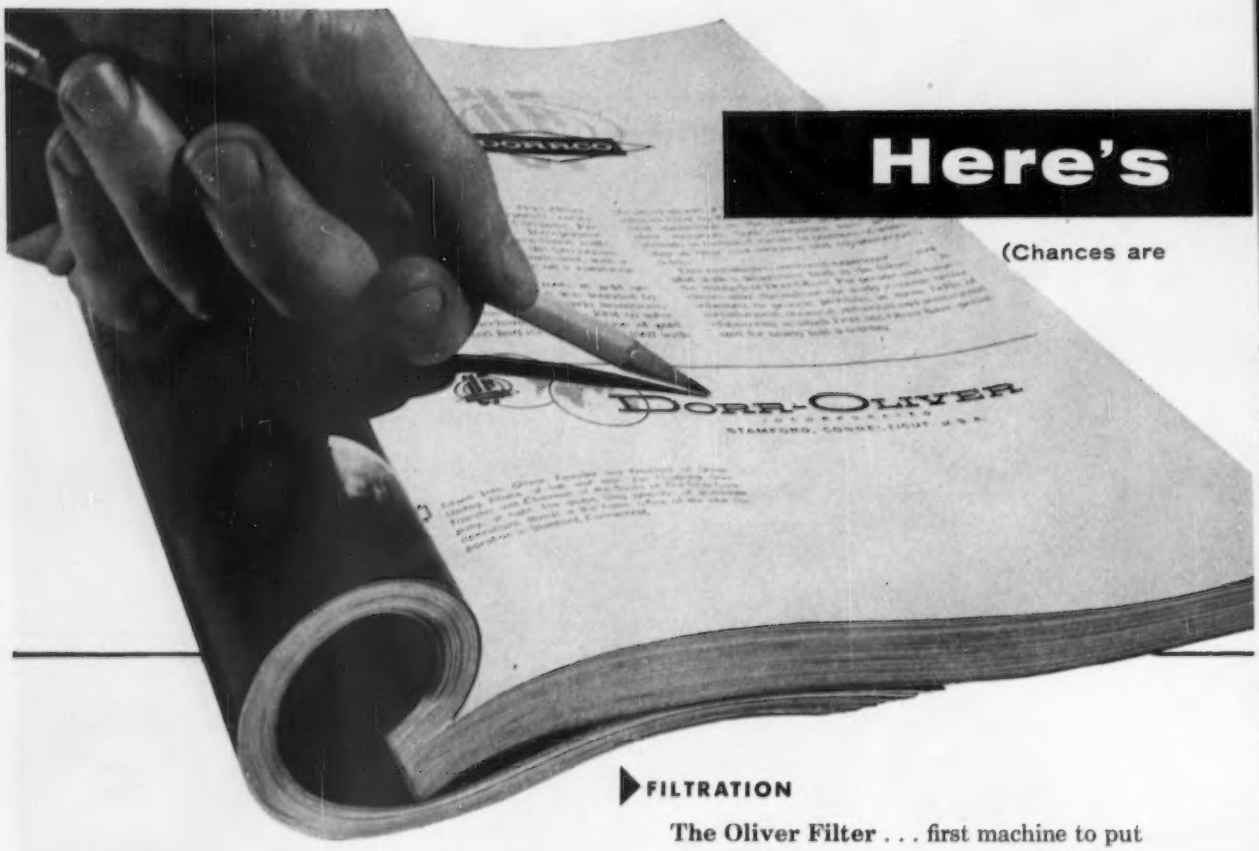
TEXACO

stays in the bearings . . . resists oxidation and separation . . . affords longer lasting protection against dirt and wear. There are three consistencies of *Texaco Olympian Grease* to meet the requirements of plain, cavity hub or anti-friction bearings.

On wire rope and open gears, use *Texaco Crater* or *Texaco Crater X Fluid*. Rope stays strong longer because *Texaco Crater* protects both strands and core. Gear life is extended because shocks and heavy loads are cushioned.

Find out how a Texaco Lubrication Engineer can help keep *your* operating costs low, *your* equipment efficiency high. Just call the nearest of the more than 2,000 Texaco Distributing Plants in the 48 States, or write The Texas Company, 135 East 42nd Street, New York 17, N. Y.

Lubricants and Fuels
FOR THE MINING INDUSTRY



CLASSIFICATION

The Dorr Classifier . . . first machine to put classification on a continuous, mechanical basis and still the standard unit for wet separations in the 28 to 200 mesh range. Now available with Type H mechanisms in a complete range of sizes.

The Dorr Bowl Classifier . . . incorporates standard machine with shallow, circular bowl for separations in 65 to 325 mesh range.

The Dorr Hydroseparator . . . for large volume flow or exceptionally fine separations.

The Dorrco Jet Sizer . . . multiple-spigot, hindered-settling classifier featuring low operating cost and extreme flexibility of cell arrangement.

DorrClone* and Centriclone* Classifiers . . . a complete range of wet cyclones in diameters from 10 mm to 24 in. . . . both single and multiple unit installations.

FILTRATION

The Oliver Filter . . . first machine to put vacuum filtration on a continuous basis and still the standard filter for washing cyanide slurries. Available in sizes ranging from 3 to 790 sq. ft. of filtering area and with a variety of discharge methods depending on cake characteristics.

The American* Filter . . . ideal for dewatering slurries which form relatively thick cakes. Features big savings in floor space and can be compartmented to filter two or more products on the same machine.

The Dorrco Filter . . . low maintenance unit where filtering takes place on the inside of the drum which also acts as the filter tank. Especially suited for dewatering fast-settling solids such as magnetites, lead sulfides, etc.

The Oliver Horizontal Filter . . . capable of counter-current washing in a single unit. Ideal for relatively slime-free slurries which form thick cakes.

The Sweetland* Filter . . . a quick open-

Our New Name

you saw it in this ad last month)

and Here's the Complete Line of Dorr-Oliver Equipment for the Mining Industry

ing batch pressure filter with individual sight glass on each leaf. Good for leaching operations and where % solids in feed is insufficient to form a dischargeable cake on a continuous unit.

THICKENING

Dorr Thickeners . . . center shaft, center pier and traction units in a wide range of types and sizes to handle every thickening or clarification problem. Individual units available to handle from one to 25,000 tons of solids in feed per day. Can be arranged in trays for countercurrent washing, parallel thickening or a combination of both in a single unit.

ROASTING & CALCINATION

Dorrco FluoSolids* Systems . . . the most significant advance in roasting techniques in the last 30 years. For roasting sulfides for metal recovery, for SO_2 production for acid manufacture, for roasting gold ores prior to cyanidation, for heat treatment steps in the concentration of various ores.

PUMPING

The ODS Diaphragm Slurry Pump . . . variable volume pump from zero on up. Discharge can be shut off while pump is running. Operates on compressed air with no mechanical linkage. Ideal for dense slurries.

Dorrco V-Type and W-Type Pumps . . . for positive, controlled removal of settled solids from Thickeners and Hydroseparators. Can be used as meters ahead of further treatment.

FOR FURTHER INFORMATION . . . The foregoing serves only to highlight the scope of Dorr-Oliver. We'll be glad to send you literature providing detailed information on our world-wide equipment and services for the mining industry. Dorr-Oliver Incorporated, Stamford, Connecticut.

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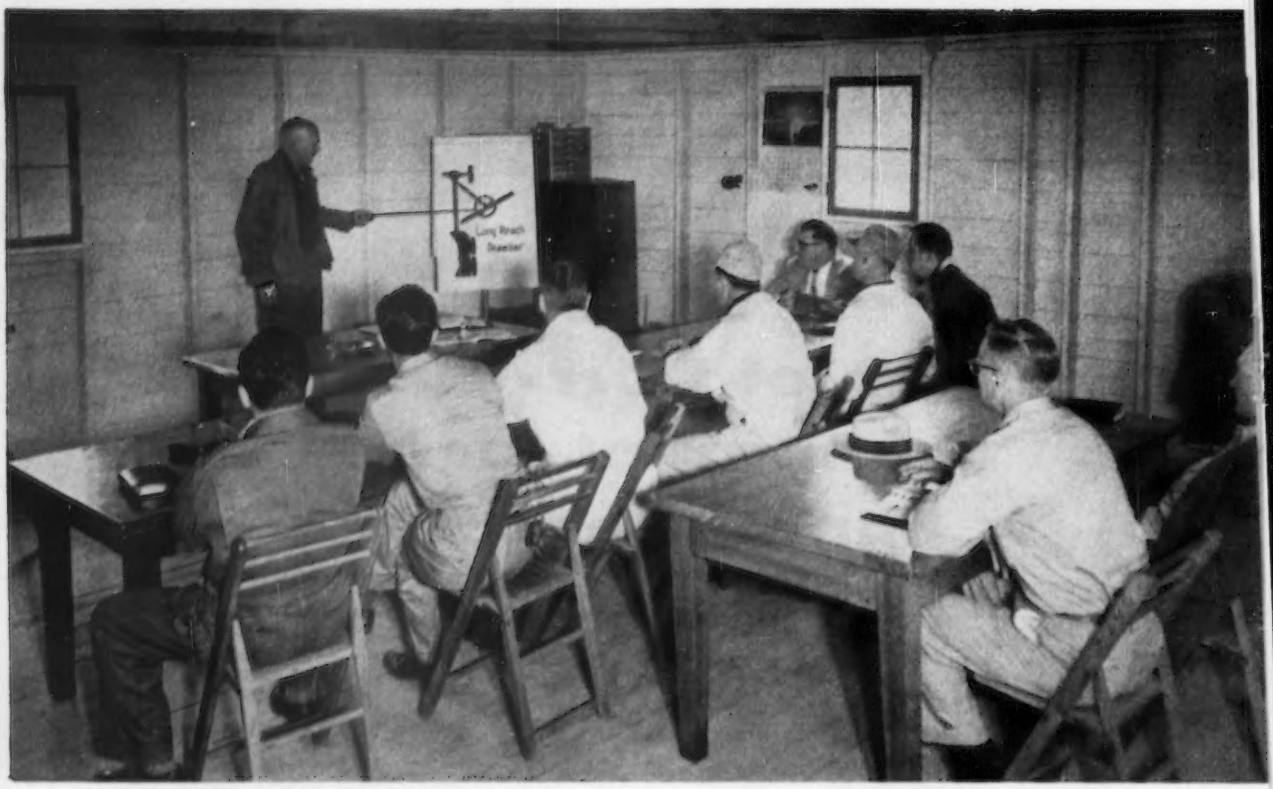


PREVENTIVE MAINTENANCE TRAINING KITS — movies, slides, charts and literature are available to help train your personnel. Your Allis-Chalmers dealer will present it for you at your convenience, or arrange to have a factory man do the job. And it can be tailored to suit your specific machines and job conditions.

How mine operators can take full advantage of Allis-Chalmers Dealer Service Plan to help protect profits

BENEFITS:

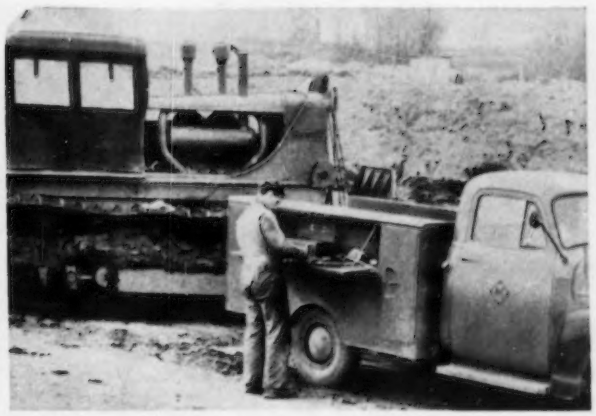
Better performance — more time on the job — longer equipment life — lower maintenance cost — higher resale value

Experience has convinced many mine operators that the Allis-Chalmers Dealer Service Plan is geared to keep equipment operating efficiently. They have found that taking full advantage of such service is easy, and that it pays big dividends. Here's why.

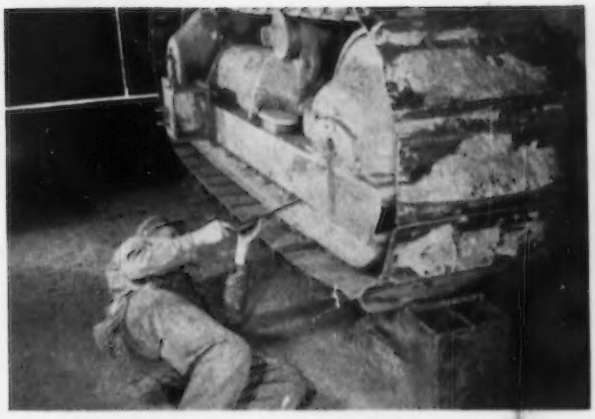
Allis-Chalmers dealers offer them a *planned* approach to service, right from the day their equipment is delivered. It covers everything from service schools to lubrication schedules, and from parts to preventive maintenance.

You owe it to yourself to take a look at the advantages this plan offers. Then see your nearby Allis-Chalmers dealer soon and ask him to give you all the facts.

ALLIS-CHALMERS
TRACTOR DIVISION — MILWAUKEE 1, U. S. A.



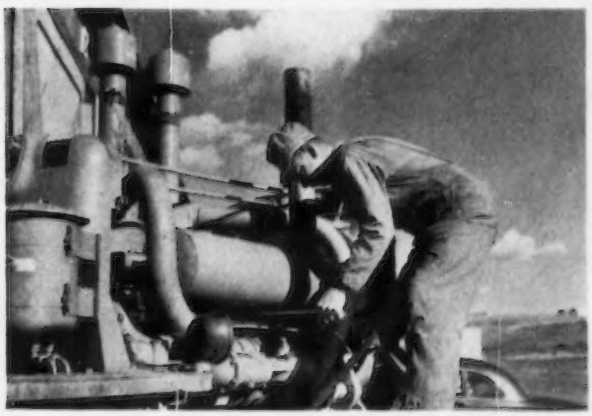
FAST PARTS SERVICE — Factory-built Allis-Chalmers parts are stocked in quantities by the *dealer*, to give you parts service as close to your job as posible. And remember, experienced equipment men agree it pays to use only standard factory-built parts.



SCHEDULED CHECKUP PROGRAM — Your Allis-Chalmers dealer will help you plan a schedule for all maintenance to keep your equipment operating efficiently. You'll save on repair bills, avoid costly downtime, get far better performance, longer life from your machines.

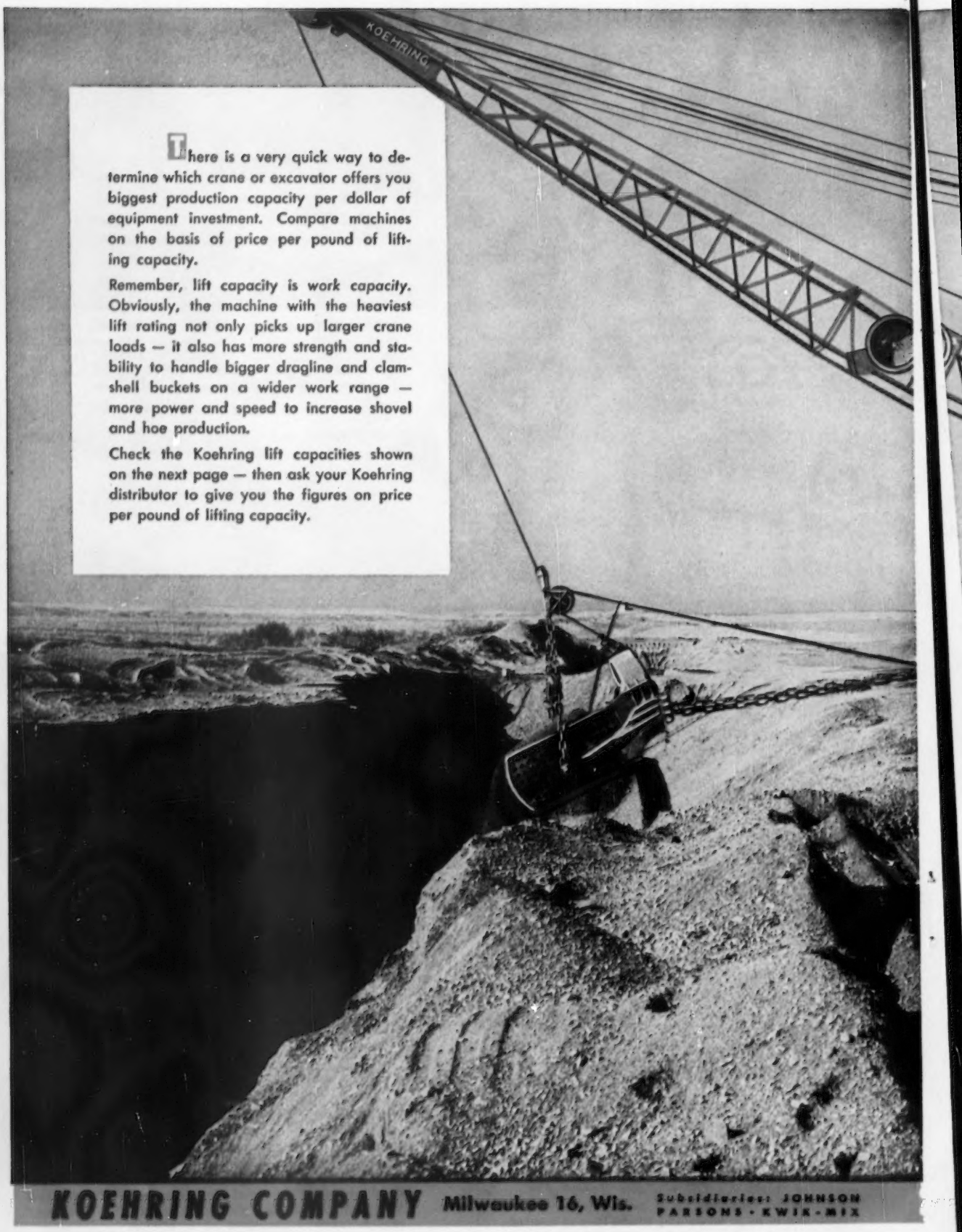
OPERATING TIPS — Allis-Chalmers dealer servicemen are trained to give your operators all the facts they need to operate your equipment most productively. For example, one of the most important things for an operator to know — how to recognize when adjustments should be made.

SPECIALIZED FACILITIES at your Allis-Chalmers dealer include factory-approved tools and all necessary service equipment. Factory-approved methods are used to save you time and money, assure finest workmanship, to help you get full value for your equipment dollar.



FACTORY-TRAINED DEALER SERVICEMEN have the specialized experience to help you spot trouble symptoms fast, help you prevent costly breakdowns. Their training never stops; they make it a *policy* to stay abreast of every development so they can be of real value to you. And they're ready to go when and where they're needed.

FACTORY SERVICE SCHOOL TRAINING is open to your servicemen just as it is for dealers. Training is by men who know the equipment best. Visual aids and easily understood literature are used. And your men discover that Allis-Chalmers design simplicity makes the equipment easy to learn . . . easiest of all to service.



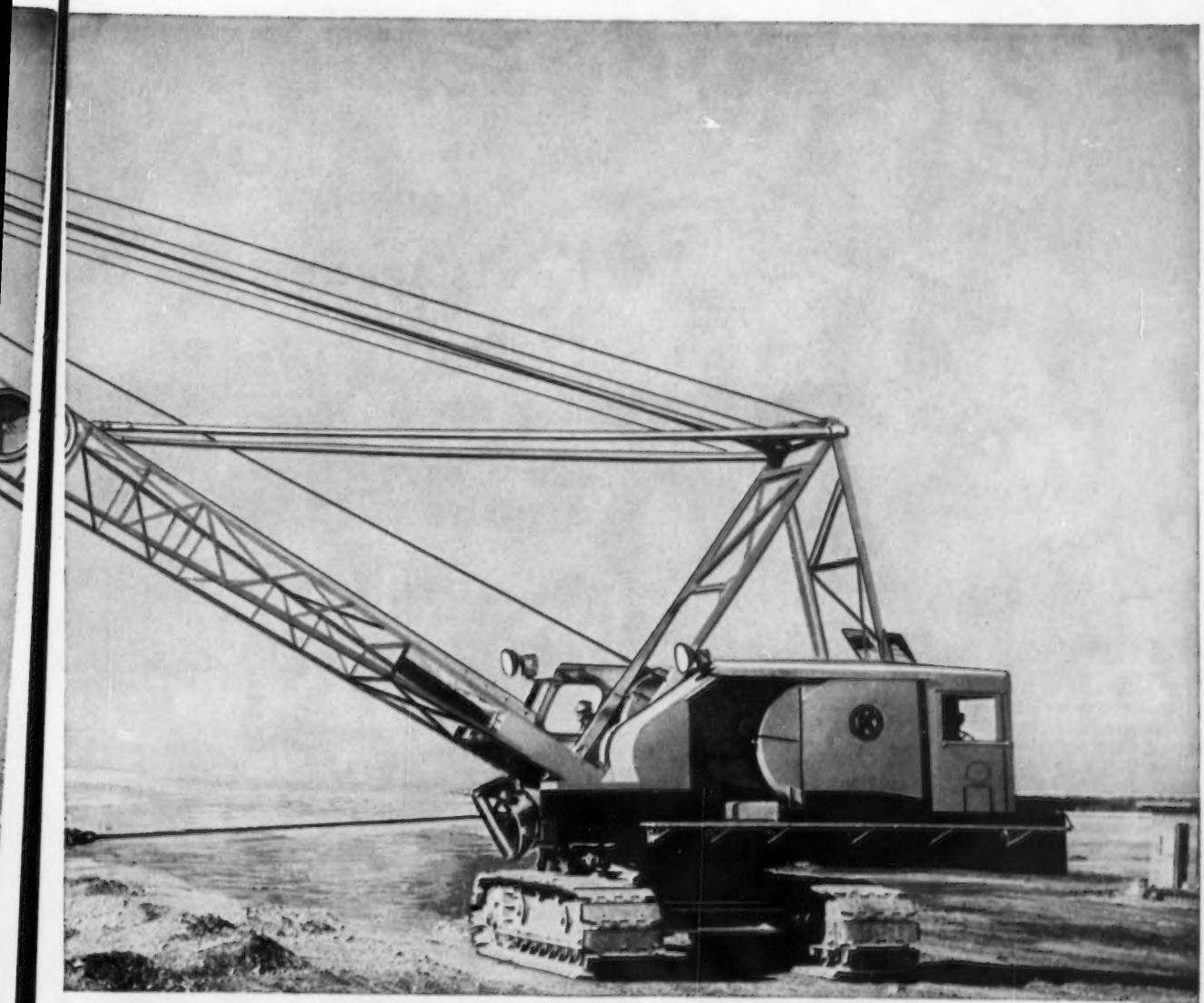
There is a very quick way to determine which crane or excavator offers you biggest production capacity per dollar of equipment investment. Compare machines on the basis of price per pound of lifting capacity.

Remember, lift capacity is *work capacity*. Obviously, the machine with the heaviest lift rating not only picks up larger crane loads — it also has more strength and stability to handle bigger dragline and clamshell buckets on a wider work range — more power and speed to increase shovel and hoe production.

Check the Koehring lift capacities shown on the next page — then ask your Koehring distributor to give you the figures on price per pound of lifting capacity.

KOEHRING COMPANY Milwaukee 16, Wis. Subsidiaries: JOHNSON PARSONS · KWIK-MIX

A/S Sydvaranger



Check price per pound of lifting capacity

KOEHRING MODEL	SIZE DIPPER	KOEHRING LIFT CAPACITIES (Crawler ratings based on 75% of tipping load. Rubber-tired machines — 85% of tipping load)		PRICE PER POUND OF LIFT CAPACITY*
205 CRAWLER	½-Yd.	20,000 lbs.	30-foot boom at 10-ft. radius	?
205 ON RUBBER	½-Yd.	30,000 lbs.	25-foot boom at 12-ft. radius	?
304 CRAWLER	¾-Yd.	27,800 lbs.	35-foot boom at 12-ft. radius	?
304 ON RUBBER	¾-Yd.	50,000 lbs.	30-foot boom at 10-ft. radius	?
405 CRAWLER	1-Yd.	40,000 lbs.	40-foot boom at 12-ft. radius	?
605 CRAWLER	1½-Yds.	72,300 lbs.	50-foot boom at 12-ft. radius	?
1005 CRAWLER	2½-Yds.	159,000 lbs.	50-foot boom at 12-ft. radius	?

*Figures available on request—ask your Koehring distributor for them.

KOEHRING HEAVY DUTY

A/S Sydvaranger

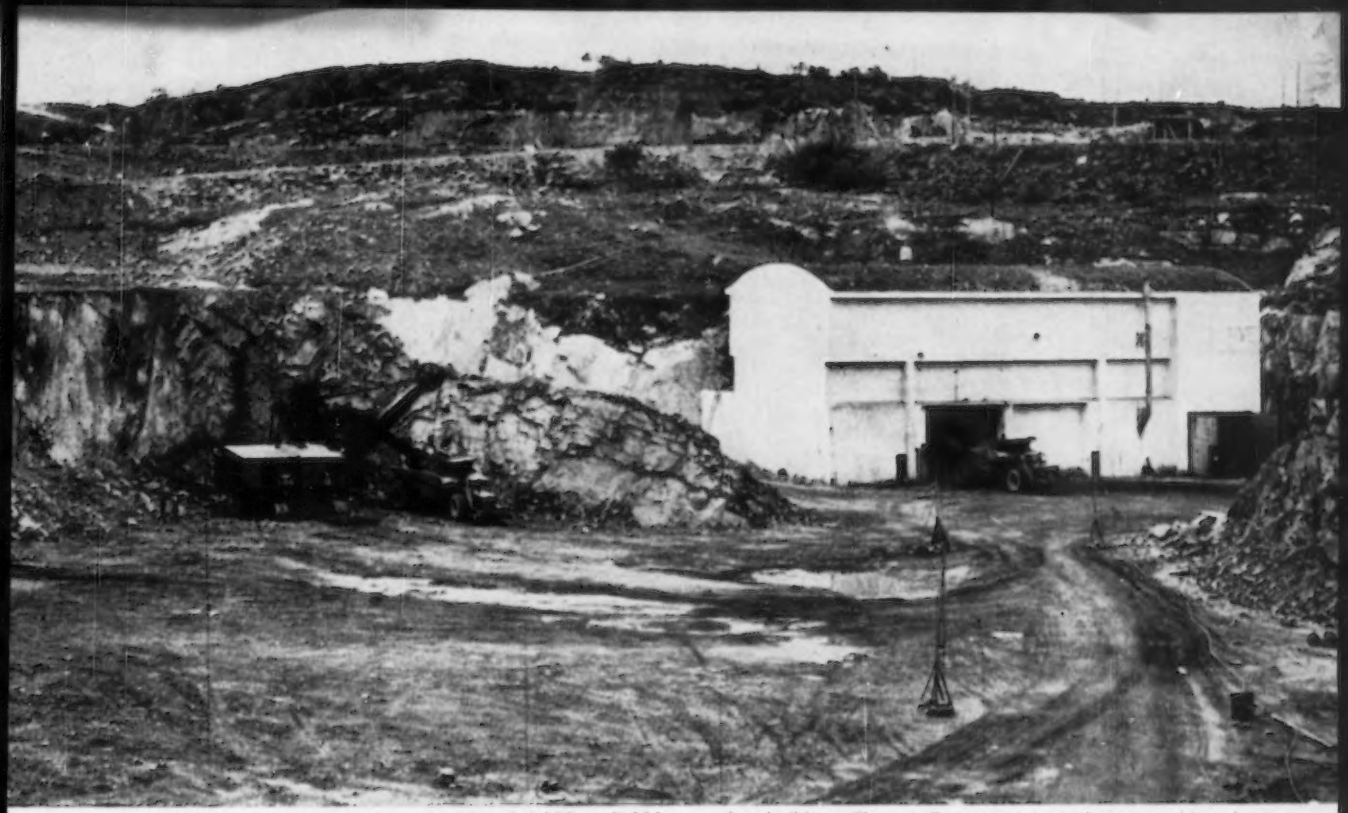
250 miles north of the Arctic Circle, at Kirkenes, the Norwegian firm of A/S Sydvaranger has been mining and exporting taconite concentrates since 1910. Many of the techniques they have developed will be used on the Mesabi Iron Range of Minnesota where large-scale taconite mining is just being started.

- **hauls taconite with 12 Tournarockers**
- **cleans pits with 2 Tournatractors**

For loading, Sydvaranger teams Tournarockers with 4½-yard shovels. This size shovel was chosen because any ore that will pass through the dipper will enter the opening of the 56-inch primary crusher. Tournarockers were chosen primarily because their large, easy-loading body and all-steel bowl would best withstand heavy shock loads. At start of post-war operation, Sydvaranger bought 6 of these Rear-Dumps. They performed so well, the company since has added 6 more. Units work year-around — in the 30° below-zero cold which grips Kirkenes much of the Arctic winter, in the 90° heat of the short summer, in rain, and in snow.

It takes only a few seconds for Tournarockers to dump 35 tons of taconite into the 56-inch primary gyratory crusher. This huge oil-cooled unit, which weighs about 600 tons, crushes the ore to minus 5 inches and discharges it into a 100-ton hopper. From the hopper, the ore is conveyed to a 10,000-ton storage silo, loaded through air-operated gates into 40-ton bottom-dump railroad cars, and hauled 6 miles to the mill. About 200,000 tons of ore are processed monthly. Plans call for Tournarockers to help remove 45,000,000 tons of ore and 20,000,000 tons of waste rock before open-pit operation gives way to underground mining.

For more information on these units, see your LeTourneau-Westinghouse Distributor



To maintain their heavy production schedule of 6,000 to 7,000 tons of taconite per 24-hour day, A/S Sydvaranger splits their fleet of 12 Tournarockers among several pits. Here, two of these giant 35-ton Rear-Dumps keep one shovel busy as they haul blasted taconite ore a short distance from a typical pit to the crusher building. These LeTourneau-Westinghouse machines have been in steady use since the mine was re-opened after the war. They replaced haul units destroyed in air raids and by the scorched-earth policy of the Nazis as they retreated from the Russians. This photo and others courtesy of Mining World magazine.

With their multiple pit set-up, Sydvaranger needs dozers which can move fast from job to job. They fill this need by working 2 Tournatractors 24 hours a day. These rubber-tired units clean up around all 4 of the shovels now in use. They travel between scattered assignments at speeds up to 19 mph. They cross railroad tracks, pavement without damage. They even have spare time to build and maintain haul roads, clear land, and do general "housekeeping" chores. Sydvaranger officials are pleased with the speed, mobility and high production of Tournatractors, and say they outperform crawler-tractors on every cleanup-type task.

Despite the very abrasive footing common to taconite mines, tires of both Tournatractors and Tournarockers have averaged 6,000 to 7,000 working hours each. Original tread on Tournarocker drive tires lasts about 4,000 hours. Recapping adds the other several thousand hours of use. The life of these big single tires is far longer than that of smaller dual tires. Six feet in diameter and 2 feet wide, the single tires have no divided face for rock fragments to wedge in, wear and tear. They roll easily over rocks that bruise the lighter duals. They contribute substantially to the high efficiency of the entire mine operation.

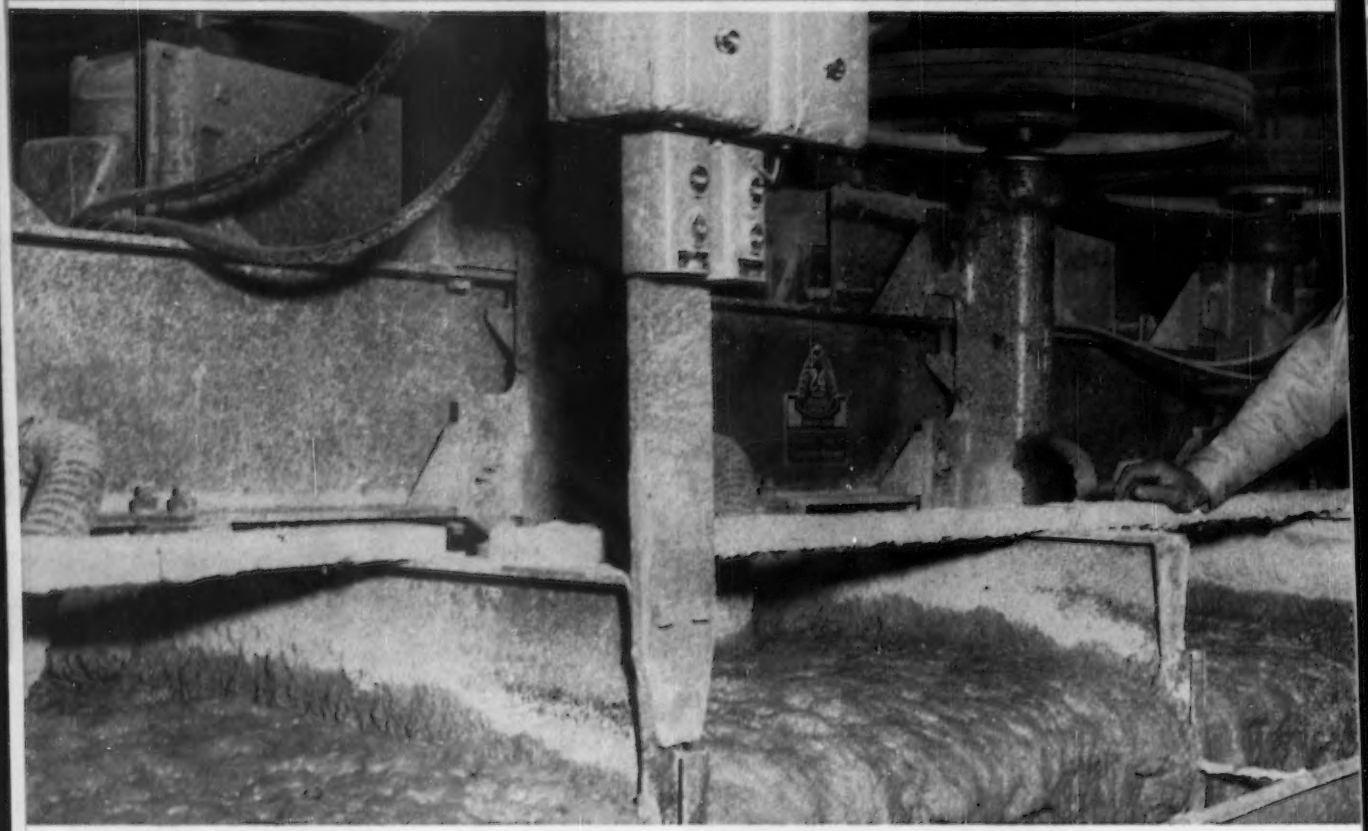
Tournarocker—Trademark Reg. U.S. Pat. Off. Tournatractor—Trademark TAR-523-M

LeTourneau-Westinghouse Company

PEORIA, ILLINOIS

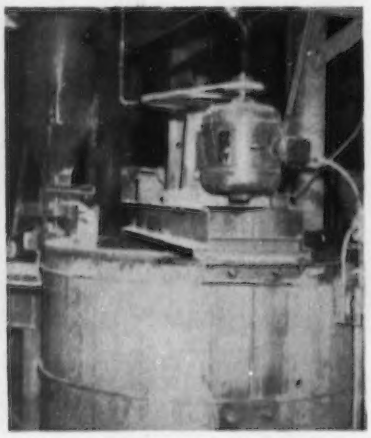
A Subsidiary of Westinghouse Air Brake Company

DENVER EQUIPMENT



This 8 cell No. 24 (43x43) DENVER "Sub-A" Super Rougher Flotation Machine, including installation, paid for itself in less than two months! In June, 1954, this machine was installed at the Glen, Mont., tungsten (scheelite) operation of Minerals Engineering Co. as a scavenger to reduce flotation tailings loss. Treating 333 T/24 hr., tailings were assaying .0577% WO_3. After installing the 8 cell No. 24 DENVER "Sub-A" Super Rougher Flotation Machine, tonnage was increased and tailings assays were immediately lowered to .0516% WO_3. This amounted to

Thorough dispersion of reagents prior to flotation is accomplished by this 12'x12' DENVER (Patented) Super Agitator and Conditioner. Patented standpipe gives positive recirculation of pulp in conditioning cycle, insures intimate reagent contact with pulp particles and higher flotation efficiency. Item No. 323.



When the DENVER Cone Type Dry Reagent Feeder is used to feed dry reagents to a DENVER Conditioner, as pictured above, it can be readily mounted to feed directly into the tank, where efficient dispersion of the reagent and pulp is affected. Feed is easily and accurately controlled. Write for Item No. 324.

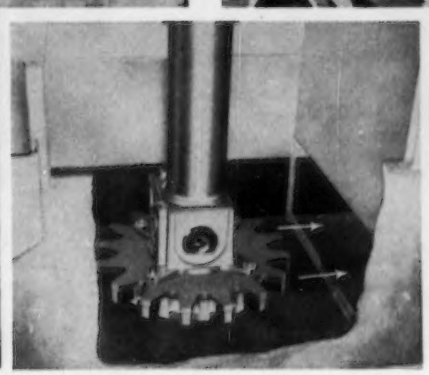
This is the new DENVER Reagent Feeder. Most important new feature is a special inlet float valve so reagents can be easily piped into feeder from a storage drum. Also, two other improvements include a new, precision Hand Wheel adjustment for micrometer accuracy, and a calibrated feed indicator. Write for Item No. 325.

"The firm that makes its friends happier, healthier and wealthier"

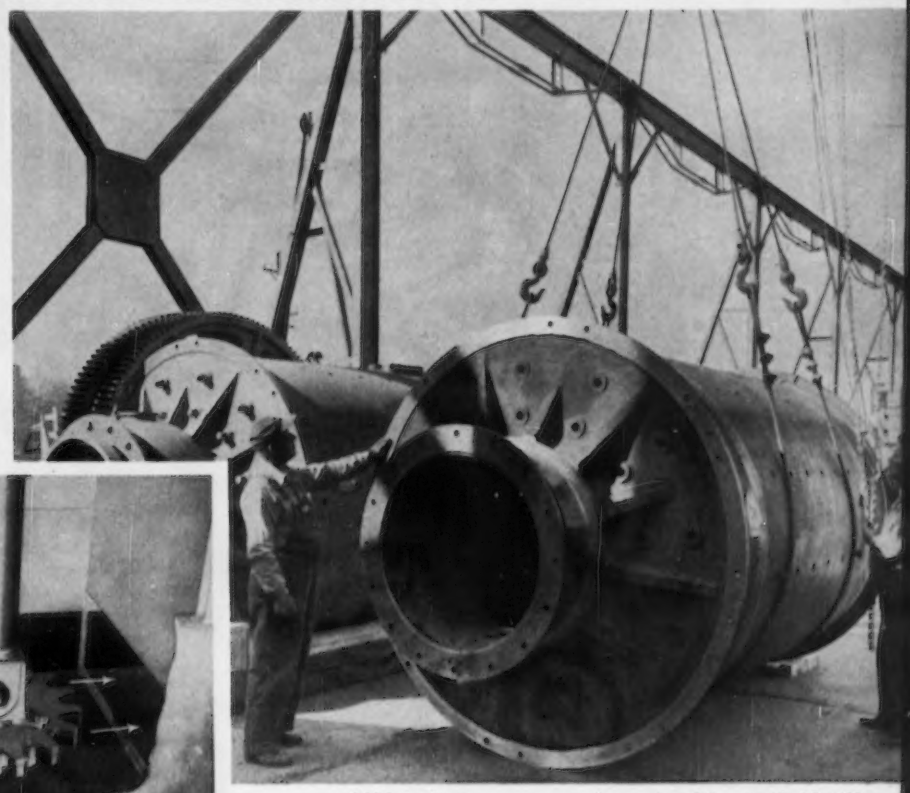
DENVER EQUIPMENT COMPANY

1400 17TH STREET DENVER 17, COLORADO

IN THE NEWS . . .



about $300 daily in new profits. Based on these profitable results, Minerals Engineering Co. decided to increase their plant capacity to 600 T/24 hrs. Three additional 4 cell No. 24 DENVER "Sub-A" Super Rougher Flotation Machines are being installed in the new roughing and scavenging circuits. Write for Item No. 321.



DECO machinists prepare two of an order of four 6'x10' DENVER Steel Head Mills for shipment to Spain for use in a 600 T/24 hrs. Cyanidation plant. Each mill is equipped with manganese liners, small diameter trunnion overflow and 125 hp. motors (due to light grinding medium). They are following the African practice of using silica grinding media, rather than forged steel grinding balls. (Each mill will operate in closed circuit with a DENVER Rake Classifier.) Item No. 322.

DENVER Disc Filter has patented segment that gives drier cake by using gravity drainage as well as vacuum. Complete removal of filtrate prevents "blow-back." This 6'-8 disc DENVER Disc Filter is used to reduced zinc flotation concentrates from 30% solids in filter feed to 8% moisture in cake. Write for Item No. 327.

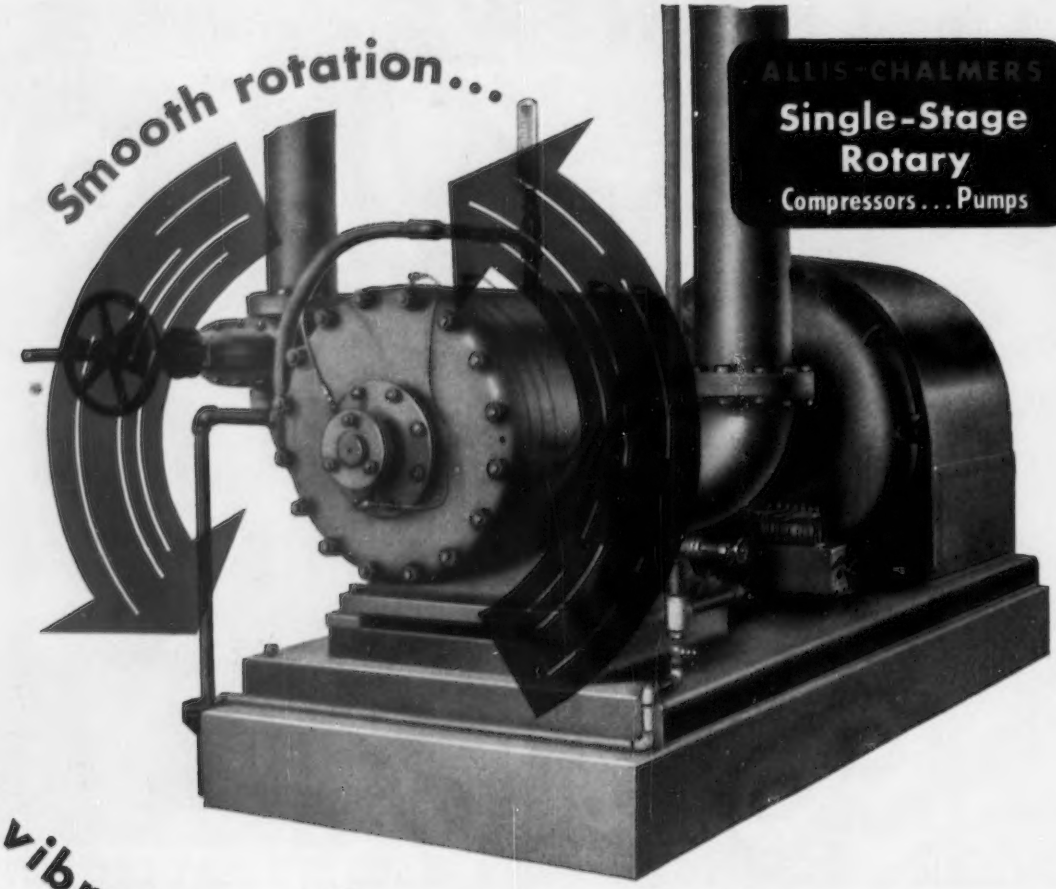
DENVER Equipment Co. bulletins on DENVER Jaw Crushers, DENVER-Dillon Screens and DENVER SRL Sand Pumps contain details on construction, capacities, operating features, related tables and data. If you have not received one through the mail, write for your copies at once. Write for Item No. 326.

The Colombia National University, Bogota, Colombia, Mineral Pilot Plant was designed and equipped by DECO. It includes complete facilities for selective flotation and gold-cyanide leaching pilot mill and testing work. Technicians were trained in the DECO Laboratory, Denver. For tests and equipment, Item 328.

WRITE TODAY, FOR ADDITIONAL INFORMATION . . . Please request additional information by the Item Number.

COLORADO SPRINGS, 500 South Sawatch Street, Phone MEIrose 3-7158
DENVER 17, Box 5268, 1400 17th Street, Cable DECO, Phone CHerry 4-4466.
CHICAGO 1, Bell Building, CEntral 6-2423.
NEW YORK, Empire State Bldg., Cable DECOYORK, Phone Chickering 4-6510.
EL PASO, 201 West 7th Street, Phone 3-8371.
SALT LAKE CITY, P. O. Box 705, Phone 84-8012.
TORONTO, ONT., 220 Bay Street, Cable DECOTOR, Phone Empire 3-8836.
VANCOUVER, B. C., Credit Foncier Building, Phone Marine 4918.
LONDON, EC2, 15/17 Christopher St., Finsbury Square, Cable DECOLON, Phone Bishopsgate 3575.
MEXICO, D.F., Avenida Juarez 14, Phone 21-1477.
JOHANNESBURG, Broadway & 9th, Sex Valley, Cable DECOJO, Ph. 25-7531.

DENVER EQUIPMENT COMPANY
1400 17TH STREET DENVER 17, COLORADO



...lowers maintenance

Smooth running single-stage *Ro-Flo* units eliminate shock and vibration inherent in reciprocating type . . . save wear and tear. But that isn't all!

THERE ARE OTHER MAINTENANCE SAVINGS inherent in *Ro-Flo* design, too. Allis-Chalmers rotary units have no valves and piston rings . . . big source of trouble in many units.

Cuts Foundation Costs

Single-stage *Ro-Flo* units run so smoothly, heavy foundations aren't needed. Small *Ro-Flo* units can be bolted directly to the floor; large ones need only a simple slab.

Modernize with rotary Allis-Chalmers units — compact, self-contained! They are built in capacities from 40 to 3200 cfm at pressures from 5 to 50 psig.

Allis-Chalmers can supply motors and control . . . the complete integrated package.

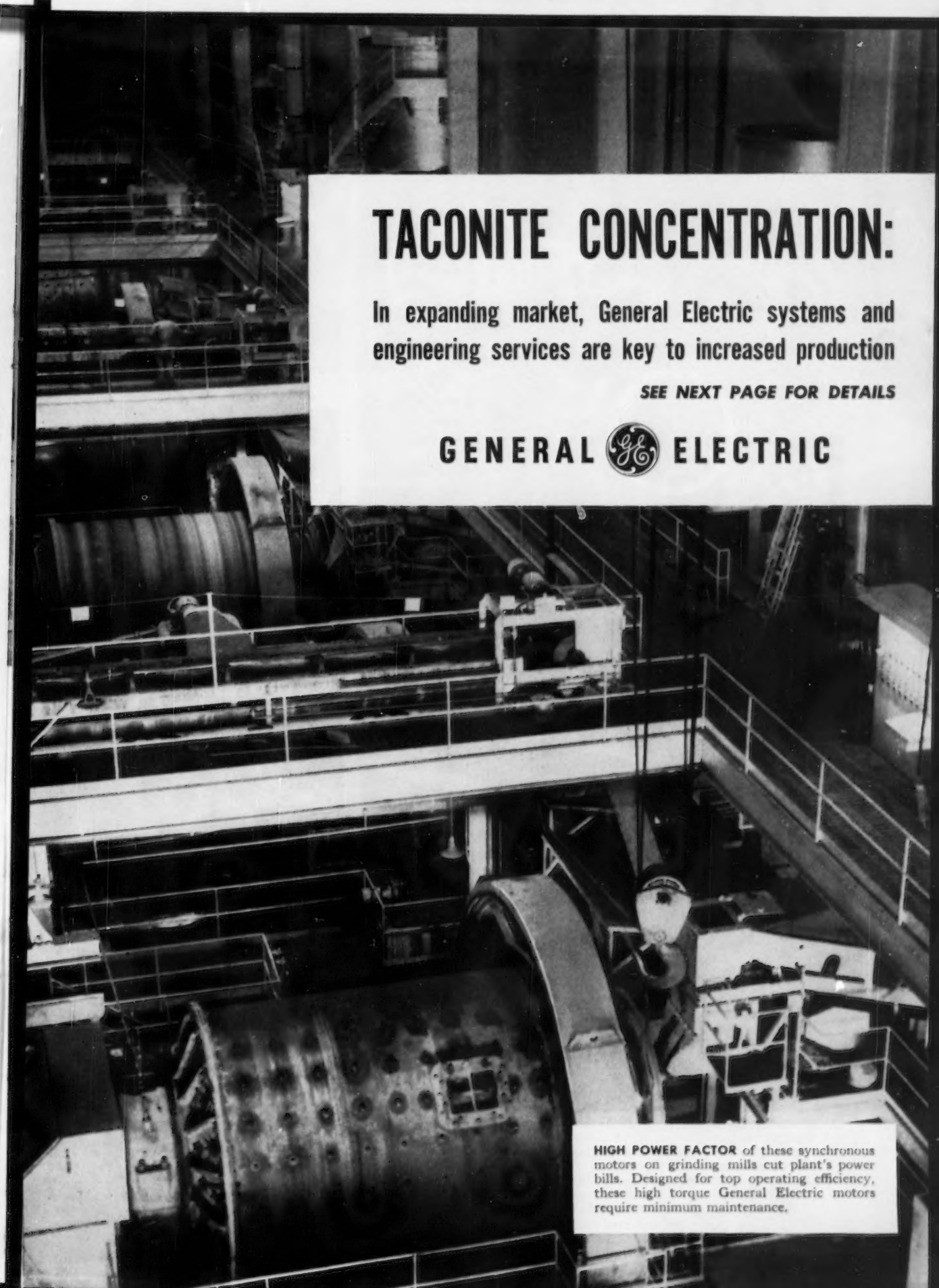
Call your nearest A-C office or write for new 12-page descriptive bulletin 16B8126, Allis-Chalmers, Milwaukee 1, Wisconsin. A-4468

Ro-Flo is an Allis-Chalmers trademark.

ALLIS-CHALMERS

EL PASO, 201 West 7th Street, Phone 3-8371.
SALT LAKE CITY, P. O. Box 705, Phone 84-8012.

MEXICO, D.F., Avenida Juarez 14, Phone 21-1477.
JOHANNESBURG, Broadway & 9th, Bez Valley, Cable DECOJO, Ph. 35-7531.



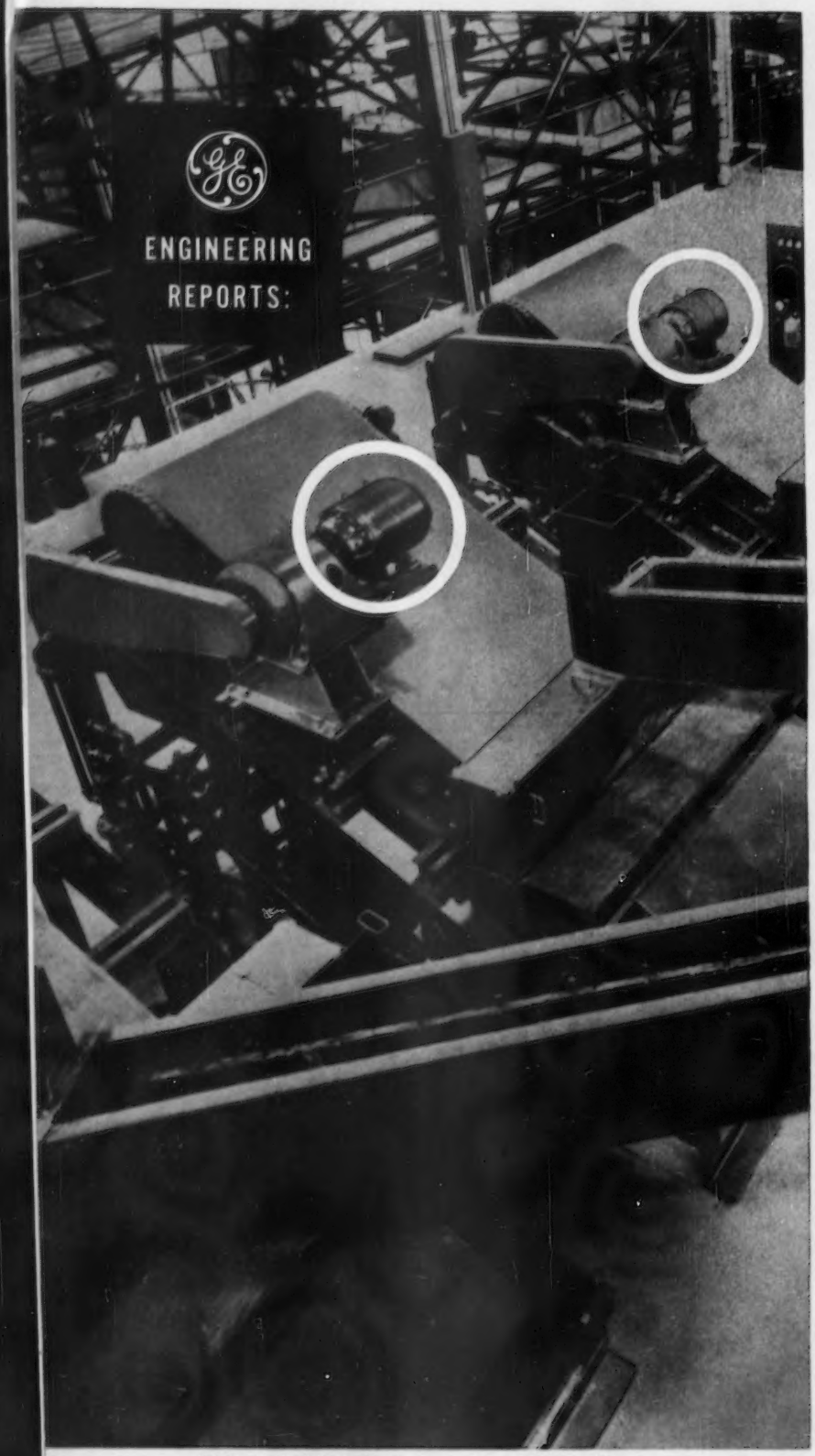
TACONITE CONCENTRATION:

In expanding market, General Electric systems and engineering services are key to increased production

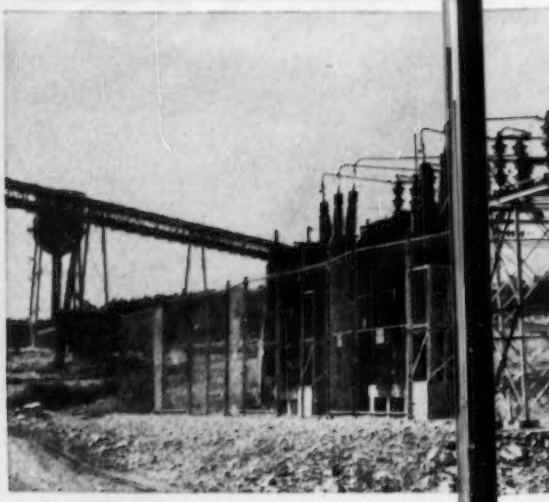
SEE NEXT PAGE FOR DETAILS

GENERAL ELECTRIC

HIGH POWER FACTOR of these synchronous motors on grinding mills cut plant's power bills. Designed for top operating efficiency, these high torque General Electric motors require minimum maintenance.

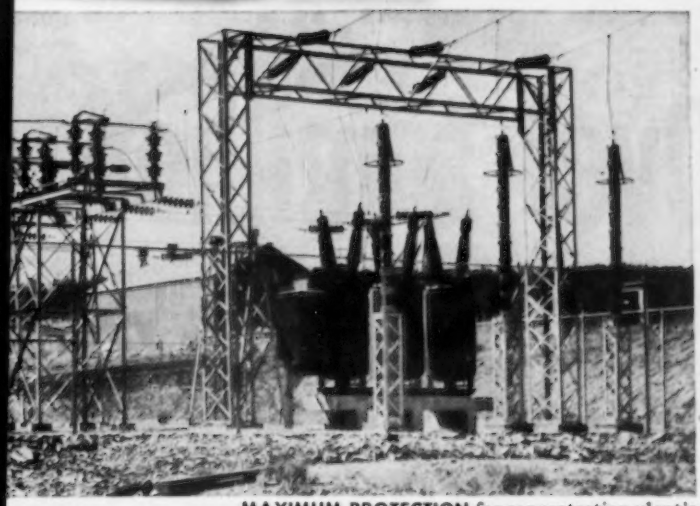


SPECIALLY-DESIGNED for taconite concentration service, rugged G-E Tri-Clad* motors have been fully tested in the taconite field. These totally enclosed, fan-cooled motors are built for long operating life and a minimum amount of maintenance.

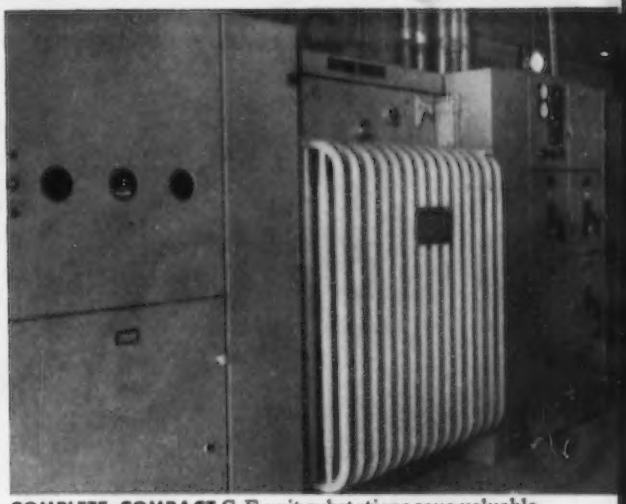


EXPERIENCED G-E ENGINEERS save you time and money in the planning, delivery, and installation of your electrical system.

EASY-TO-INSTALL G-E Cabinetrol* control centers are delivered factory assembled. Located in ventilated control rooms, they give centralized control for plant operations



MAXIMUM PROTECTION for concentration plant's distribution system is assured by G-E packaged substations. They are designed with standard components to meet individual requirements



COMPLETE, COMPACT G-E unit substations save valuable floor space. They provide power for round-the-clock operation of plants. Factory assembled, they are easy to install and can be expanded with ease.

G-E electrical systems and engineering services help

INCREASE TACONITE CONCENTRATE OUTPUT

Taconite concentration uses power, and lots of it. And, with the production of iron ore concentrates expected to increase 30 times by 1970, the importance of a flexible co-ordinated electrical system cannot be overlooked. For the key to top production in taconite concentrators is a co-ordinated electrical system which incorporates all electric equipment into a smoothly functioning unit. To help you plan your system, General Electric offers these engineering services.

APPLICATION ENGINEERING:
G-E Engineers, experienced in the taconite processing field, will work with you, or your consulting engineers. They will help design an electrical system to fit your individual needs today, which can be readily adapted in future expansions.

PROJECT CO-ORDINATION:
G. E. will co-ordinate selection, delivery and installation of all electric equipment to assure that the right equipment arrives at the right time.

FIELD ENGINEERING:
Field Engineers are available to assist with the installation and start-up of your electrical system.

PRODUCT ENGINEERING:
Extensive tests in taconite plants and research laboratories are conducted by G-E Product Engineers to assure that G-E electric equipment is designed to meet the rugged requirements of taconite service.

These G-E engineering services are designed to help you get the best electrical system for your particular needs. They will also save you time and money in the ordering, delivery, and installation of your electric equipment. For more information about G-E electrical systems and services, contact an Apparatus Sales Representative at your nearest G-E Apparatus Sales Office. General Electric Company, Schenectady 5, N. Y. 660-32

Engineered Electrical Systems for the Mining Industry

GENERAL ELECTRIC

EASY-TO-INSTALL G-E Cubicletor control centers are delivered factory assembled. Located in ventilated control rooms, they give centralized control for plant operations

Over a million

with ONE

IT GULPS DIRT BY THE CARLOAD. The Green Hornet—a 50-cu. yd. electric coal stripping shovel—must operate continuously day and night to justify its expensive existence. The long service life of TIGER BRAND Hoist Rope helps keep this goliath on the job with few interruptions or delays.

The Right Wire Rope will do the trick!

GENERAL ELECTRIC

yards of tough digging

Tiger Brand Hoist Rope

THE first TIGER BRAND Hoist Rope installed on this coal stripping shovel worked 65 shifts in 23 days before it was replaced. It moved 1,161,155 cu. yds. of overburden in those three weeks.

That's good service in a punishing coal stripping operation. This big 50-cu. yd. shovel is busy every hour of the day and night, stripping overburden for Hanna Coal Company at Georgetown, Ohio. It averages as high as 54,000 yards a day. Its hoist rope really has to be *rugged* to work at that clip. The first TIGER BRAND Rope worked so well that an identical TIGER BRAND Hoist Rope replaced it.

This is not a unique case. We know of many TIGER BRAND Ropes on heavy-duty earth moving equipment that have moved a million or more yards before replacement. In cases of easier digging, service in excess of 2,000,000 cubic yards is not unusual. On *any* job, the correct TIGER BRAND Rope gives you the longest possible service . . . steady, rope-after-rope performance that *keeps down costs.*

Send the coupon for more information.

FREE ROPE BOOKLET

American Steel & Wire
Dept. C-25, Rockefeller Building
Cleveland 13, Ohio

Please send me, without obligation, a copy of your helpful wire rope selection guide, "The Right Rope for the Job."

Name.....

Company.....

Address.....

City & State.....

AMERICAN STEEL & WIRE DIVISION, UNITED STATES STEEL CORPORATION, GENERAL OFFICES: CLEVELAND, OHIO
COLUMBIA-GENEVA STEEL DIVISION, SAN FRANCISCO • TENNESSEE COAL & IRON DIVISION, FAIRFIELD, ALA., SOUTHERN DISTRIBUTORS
UNITED STATES STEEL EXPORT COMPANY, NEW YORK

USS AMERICAN TIGER BRAND WIRE ROPE

USS

Excellay Preformed

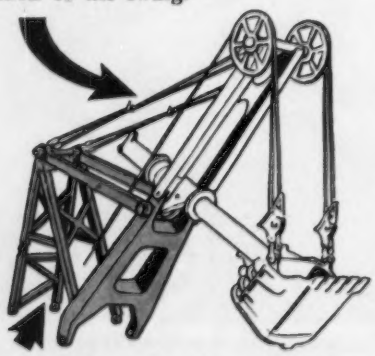
UNITED STATES STEEL

an EXTRA MARGIN of Strength

without Excess Weight

The unique two-section boom used on Bucyrus-Erie 4½- to 8-cu. yd. Ward Leonard electric shovels solves one of the problems of front-end construction on heavy-duty excavators in a sound, practical way. It provides the strength needed to withstand the shock loads of digging, yet is remarkably light in weight to help keep swing inertia low.

Upper boom section, bridge-strand connected to the A-frame, is relatively lighter in construction, because it has to carry only the loads resulting from the pull of the hoist ropes and from the acceleration and deceleration of the swing.



Sturdy lower section, securely attached to the A-frame by pin-connected struts to form an integral part of the machine, has ample strength to take the stresses and shock loads of the digging cycle. Widespread boom feet provide a brace effect to take swing loads . . . no cable suspension or sway braces are required.

The two-section boom is only one example of *that extra margin* built into Bucyrus-Erie heavy-duty excavators—an extra margin in design *that pays off in extra loads and more output.* There's much more to the story—the tubular dipper handle, the independent rope crowd, the twin dual hoist ropes, the deck location of crowd machinery, the improved dipper design. Write for complete information on the model of your choice—the 4½-yd. 110-B, the 6-yd. 150-B, and the 8-yd. 190-B. 18L54

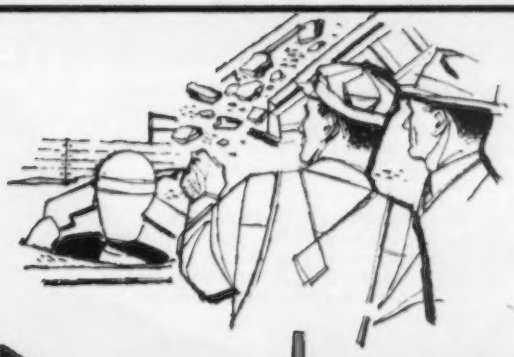
BUCYRUS ERIE

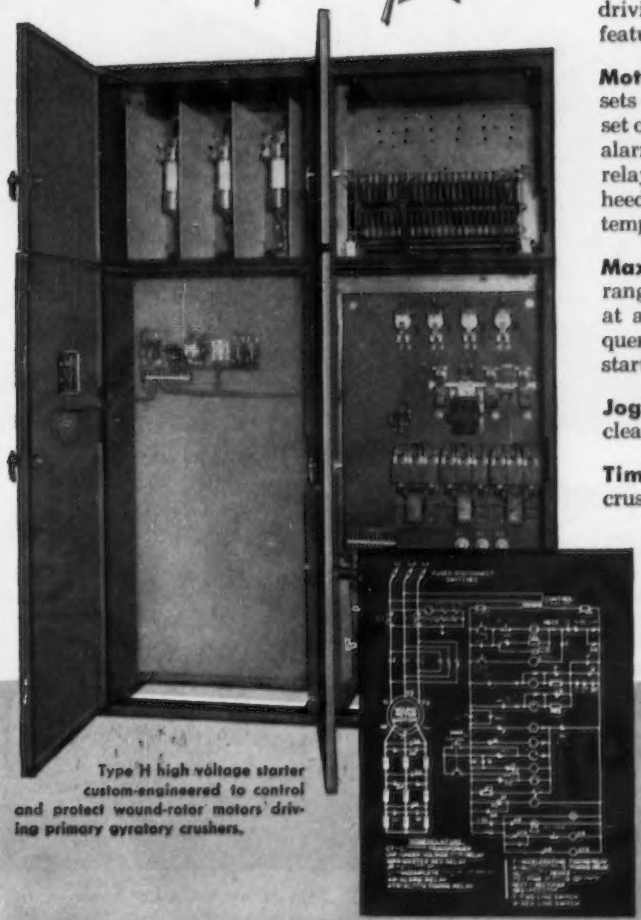
SOUTH MILWAUKEE, WISCONSIN

CUT CRUSHER DOWN-TIME

with Custom-Engineered

ALLIS-CHALMERS CONTROL





Type H high voltage starter custom-engineered to control and protect wound-rotor motors driving primary gyratory crushers.

Allis-Chalmers has built and installed hundreds of gyratory crushers in the past 75 years. Drawing on this experience, A-C engineers have developed a control circuit designed to cut costly down-time in the rough-tough job of rock and ore crushing. This control circuit is considered by rock products operators to be the ultimate in control and protection for wound-rotor motors driving primary gyratory crushers. Here are some features of this circuit:

Motor Overload Protection — Two separate sets of thermal overload relays are provided. One set operates on slightest overload to sound remote alarm horn and energize indicating light. These relays do not stop motor. If warnings are not heeded, a second set of relays stops motor when temperature reaches danger point.

Maximum Torque Starting — Control is arranged so that maximum torque can be obtained at any time while motor is being started. Frequently, application of maximum torque permits starting a stalled crusher and clearing jam.

Jog-Reversing Controller permits rocking to clear jam.

Time-Delay Undervoltage Relay allows crusher to ride through momentary voltage dips.

Stall Protection — On currents greater than normal load peaks, the motor is disconnected through an instantaneous current relay.

Write for details. Explanatory material is yours for the asking. See your A-C representative or write Allis-Chalmers, Milwaukee 1, Wisconsin.

A-4525

ALLIS-CHALMERS

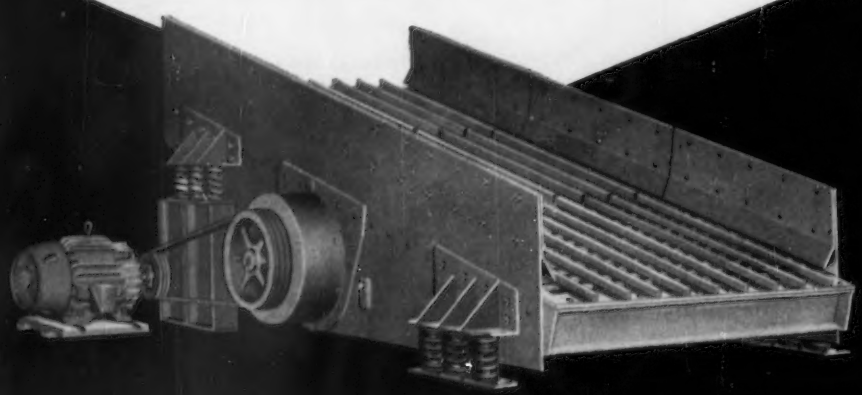
For the best in heavy-duty scalping you need every one of the BIG 4

1 GREAT STRENGTH Massive frame utilizes heavy-section ship channels and H-beam members. Welded deck is securely riveted to thick side plates. Stress-relieved construction easily withstands up to 40-in. boulders dropped from feeder.

2 HIGH CAPACITY Efficient vibrator mechanism permits screening extremely high capacities of sticky ore. Deck can be grizzly or perforated plate, furnished in welded carbon or cast abrasive-resistant steel.

3 EFFECTIVE SEPARATION All vibration is isolated from foundation by large, square-end helical springs and is concentrated in the live deck for thorough action of deepest bed.

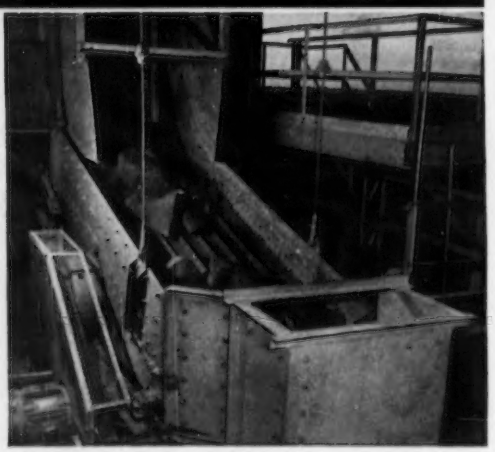
4 TROUBLE-FREE OPERATION Automatic controls limit motion during acceleration and deceleration. Over-size, self-aligning roller bearings and hydraulic bearing removal device.



New LINK-BELT vibrating screen combines all the features essential to low-cost ore handling

LINK-BELT designed and built this heavy-duty scalping screen to the specifications of the men who will use it. Efficient sizing action has been combined with the ruggedness necessary for severe service to produce a screen of the caliber required to do your job.

This new screen can improve your operation by effectively keeping fines out of your primary crushing circuit without being a bottleneck. Ask your Link-Belt representative for all the facts or write for Folder 2461.



Link-Belt heavy-duty scalping screen provides high-capacity sizing at this Minnesota iron ore operation.

LINK-BELT

VIBRATING SCREENS

LINK-BELT COMPANY: Chicago 9, Indianapolis 6, Philadelphia 40, Atlanta, Houston 1, Minneapolis 5, Duluth 2, San Francisco 24, Los Angeles 33, Seattle 4, Toronto 8, Springs (South Africa), Sydney (Australia). Offices in Principal Cities. 13.323

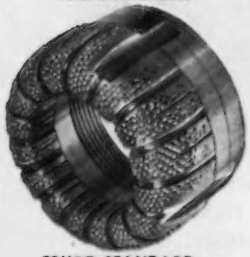
TRUCO CORING BIT

TRUCO CONCAVE BLAST HOLE BIT

TRUCO PILOT BIT

TRUCO IMPREGNATED CORING BIT

TRUCO REAMING SHELLS



TRUCO STANDARD OIL FIELD BIT

FINEST QUALITY DRILL BORTZ

The Charm of Booie, The Witch Doctor

Booie, the Kaffir witch doctor, didn't want to part with the charm. Often he had made big magic with it in his ceremonial dances and without it he might lose face. And, didn't it have miraculous powers?

Schalk van Niekirk, the old Boer trader, thought so—at least it had the power to make him a very wealthy man, for this pebble was four times the size of the one he had sold two years before.

So, all day long they haggled and Schalk brewed pot after pot of Dutch coffee, heavy with sugar, well flavored with a magical potion from a stone bottle and served it with the free hand of a man who feels a fortune tickling his fingertips.

Finally, he stood up, stamped out the fire and said, "Booie, come to my kraal and I will give you 500 sheep, 10 oxen, and a horse—I have nothing more." Booie held out his hand; suddenly, he was incredibly rich.

Schalk sold the big diamond—it weighed 83½ carats—for $56,000, a handsome fortune in 1870. In London, after cutting to 46½ carats, it proved to be of the finest color and brilliance, and the Countess of Dudley gladly paid $125,000 for it. In her tiara it became "The famous Dudley Diamond."

Diamonds are precious in drilling, too, because they provide the vital, time-saving, cost-reducing element in Truco Diamond Bits. They assure that irresistible cutting power which takes Trucos through any formation, swiftly, accurately, thriftily, dependably. Have you consulted your Truco Diamond Bit Catalog lately?

TRUCO DIAMOND BITS

by

WHEEL TRUEING TOOL COMPANY

3200 W. Davison Avenue, Detroit 38, Michigan

WHEEL TRUEING TOOL CO. OF CANADA, LTD.
575 Langlois Avenue, Windsor, Ont., Canada

SPECIFY FIRST . . . REPLACE LAST
AMSCO DIPPERS FOR MINES

Mine superintendents with years of on-the-job experience, regularly specify manganese steel dippers on new equipment. Most specify by name—Amsco.

The reason is obvious. Amsco manganese steel dippers will stand up longer under rugged mine treatment and down time will be cut to a minimum.

Next time you order a power shovel or replacement dipper, specify long life right on your purchase order . . . *specify an Amsco manganese steel dipper.*

AMERICAN Brake Shoe COMPANY

AMERICAN MANGANESE STEEL DIVISION
Chicago Heights, Ill.

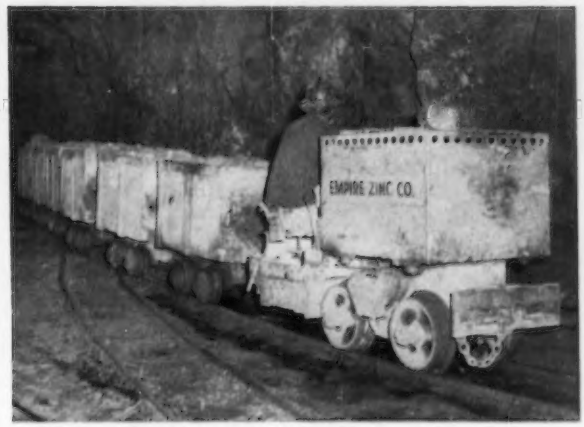
DRILL BORTZ

2141

▲ Mancha's Titan AN—4 ton operating weight. Two types of transmission available to best meet haulage requirements.

Each model, from 1½ tons to 9½ tons, is built for rough underground service where water, muck and rough track are every-shift conditions.

- Heavy-duty motors for that "extra" car on every train
- Strong, dirt-proof, water-proof battery boxes
- Trim design for use in narrow drifts or haulage-ways
- Safety for the motorman — large cab space, rugged steel end cabs with rounded bumpers, rolled or cast steel side plates
- Strength throughout without excess weight which wastes battery capacity
- Simplicity of design that makes inspection easy, repair seldom necessary



2142

◀ Mancha's Little Trammer — 1½ tons operating weight. Track gauge easily adjusted from 18" to 30", end cab folds for short caging length.

MAIL THE COUPON

Mancha Storage Battery Locomotive
Division GOODMAN Manufacturing Company
4850 South Halsted Street, Chicago 9, Ill., U. S. A.
E&MJ-255
Send your mine haulage data form.

NAME

FIRM

ADDRESS

CITY ZONE STATE

MANCHA STORAGE BATTERY LOCOMOTIVE
Division GOODMAN Manufacturing Company
4850 SOUTH HALSTED STREET CHICAGO 9, ILL., U. S. A.

Keep your buckets moving with TIREX

Notice the line between the bucket and boom base? That's electric trailing cable furnishing power to the shovel. Whatever happens to it to stop current flow stops the shovel, idles workmen, costs money.

Spilling ore beats on the cable. The truck behind the upper end of the dipper sticks runs over it sometimes. High temperature of the sun-heated pit and current load fry it. It gets abraded, strained, soaked in water, and covered with oil. That's why it should be the best cable that money can buy.

Simplex-TIREX High Voltage Portable Cable has the toughest, most abrasion-resistant jacket known. It is designed and engineered especially for mining requirements. It is the only trailing cable made with the famous Selenium Neoprene Armor and is cured in lead. Used to transmit power to shovels, dredges, cranes, and draglines, it is resistant to moisture, acids, alkalies, oil, flame, and sunlight.

If you're not now using Simplex-TIREX Trailing Cable, write for Catalog 1012 to the address below, or contact your nearest Simplex representative.

Simplex WIRES & CABLES

TIREX CORDS AND CABLES *are made only by the*

SIMPLEX WIRE & CABLE CO., 79 Sidney St., Cambridge 39, Mass.

Asbestos mine moves 4000 tons daily on 8 trucks

The Johnson's Company, Ltd., with headquarters at Thetford Mines, Quebec, has been mining and processing asbestos ore in this region for close to 70 years.

Its newest mill and open-pit mine at nearby Black Lake represents an $8,000,000 development and the last word in modern equipment. Typical of its efficient methods is the daily movement of 4000 tons of asbestos ore on 8 big Mack dump trucks over a ¾-mile haul from the mine to the primary crusher.

To keep its ore moving on uninterrupted schedule, The Johnson's Company decided their best investment was Mack. They accordingly purchased the 8 Model LV, diesel-powered Mack trucks of 22½ tons capacity. Actual performance of these trucks, each carrying 500 tons daily, has more than confirmed the wisdom of the company's choice.

MACK TRUCKS Empire State Building, New York 1, N. Y.

CRANE VALVES have longest life in this sulphur pit

THE CASE HISTORY— Leakage in steam lines to sulphur pit heating coils was hindering operations at International Minerals & Chemical Corp. plant at Lockland, Ohio. The condition prevented servicing of traps, strainers and the heating coils.

Valves that leaked beyond repair after as little as 6 months' service were the source of the trouble. Their seating as well as packing failed to stand up.

In January, 1953, after trying other types, Crane 14½P Plug Type Disc Globe Valves were installed. Today, they're still giving excellent service at low cost. Recently, the steam piping was completely replaced—the Crane valves were repacked and put back in the lines. That's all the maintenance they needed after 18 months in this severe service.

Crane 150-Pound No. 14½P Plug Type Disc Brass Valves

Long-wearing, hard seating surfaces in a rugged, well-proportioned, Crane-designed body make these valves exceptionally suited for steam and other severe services. Consult your Crane Catalog or your Crane Representative.

CRANE CO.

General Offices: 836 S. Michigan Ave., Chicago 5, Illinois
Branches and Wholesalers Serving All Industrial Areas

VALVES • FITTINGS • PIPE • PLUMBING • HEATING

CRANE'S FIRST CENTURY . . . 1855-1955

M. H. TREADWELL ENGINEERING SERVICES

ON A WORLD-WIDE SCALE

North, East, South and West—in many parts of the world—you will find installations engineered by M. H. Treadwell.

The excellent design, accuracy and completeness of these projects are outstanding. Each is engineered for economical, efficient construction, and profitable operation. This is evidenced by our list of satisfied clients.

For a better engineered job and for economy all down the line, consult us when you are planning a new plant, an expansion or an alteration. The services of our engineering department are available to you for the handling of any size project—large, medium or small.

Our engineers will be glad to discuss your problems with you at any time, without obligation.

M. H. TREADWELL COMPANY, INC.
140 Cedar Street, New York 6, N. Y.
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208 So. LaSalle St., Chicago 4, Ill.

TREADWELL

SERVICES
ENGINEERING AND
DESIGN

TR-7

drilling for 400,000

KW of electricity...

Some 200 miles north of Sao Paulo, Brazil, Ebasco Services is engineering and constructing the Peixoto Hydro Electric Development, for Cia. Paulista de Forca e Luz. When completed, the harnessed waters of the Rio Grande will furnish 400,000 KW of electricity for the industrial development of the area.

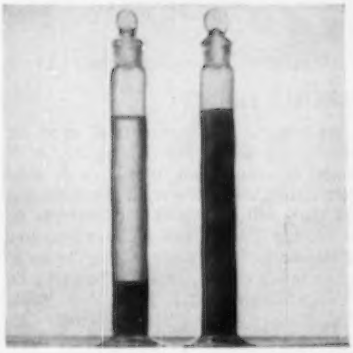
To build the dam and accessways to it, meant moving many hundred tons of earth and rock — and for that big job Crucible Hollow Drill Rods were chosen. Experienced construction men *know* they can depend upon these rods for *optimum* performance *at lowest cost per foot of hole drilled.*

That's because Crucible Hollow Drill Rods are built to *tool steel* standards, by the leading producer of tool and special purpose steels. That means fewer broken rods or valuable bits lost on the job. So be sure that on your drilling jobs you specify Crucible Hollow Drill Rods. *Crucible Steel Company of America, Henry W. Oliver Building, Pittsburgh 30, Pa.*

CRUCIBLE first name in special purpose steels

Crucible Steel Company of America

E&MJ NEW PRODUCTS DIGEST



SETTLING RATE IMPROVEMENT: Solution left treated with 0.03 lb Separan per ton dry solids; Right, untreated ore, 15% solids. Picture taken 30 sec after treatment.

FILTRATION RATE IMPROVEMENT: At left is untreated filter cake. Weight is 4.55 g; moisture, 28%; rate, 1,044 lb per day per sq ft. At right, cake treated with 0.2 lb Separan per ton dry solids. Weight is 24.28 g; moisture, 20%; rate, 5,900 lb per day per sq ft. Pictures were made after a 45 sec cycle which included 15 sec filtering, 5 sec air drying, 15 sec water washing and 10 sec air drying.

New Coagulant May Mean Better Flotation

A new coagulant or flocculating agent that promises to be a new advance in the separation and filtering of water dispersed solids in industry has been announced by Dow Chemical Co. under the trade name of Separan 2610.

Of particular interest to the mining industry, this new material may revolutionize the steps necessary to remove solids from water solutions in many industrial applications. It offers a better solution to almost all problems where a separation of material from a water suspension is necessary.

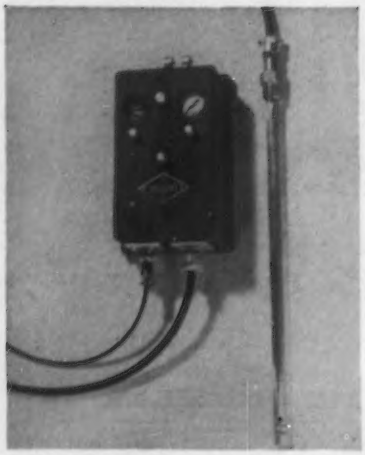
For example, its use has decreased material losses by as much as 80%. The overhead clarity in settling operations has been increased by as much as five times. Thus the use of Separan 2610 has increased total product recovery by as much as 5% and greatly reduced waste disposal problems by improving overhead clarity.

This new material is effective in dosages as small as one part per 2-million parts of dispersed solids. Its capacity for tying particles of material together is so great that compared to other types of flocculating materials the amount used may be reduced as much as 30 times, according to the announcement. This means a considerable saving in the cost of flocculant and equipment required for such industrial operations.

Separan has high capacity for increasing the filtration rate in separation processes. These rates are increased to the point that the filter area normally required may be reduced as much as 88%. Another important characteristic of its filtering action is that in certain situations the total moisture content of the filter cake may be reduced as much as 5%.

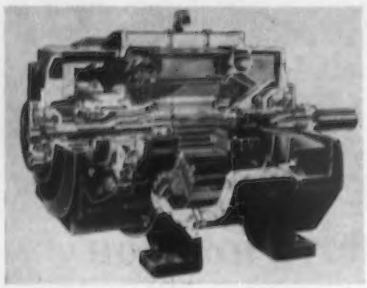
Other special advantages are its effectiveness over an extremely wide pH range and the fact that Separan may be stored indefinitely without need for preservatives. A synthetic, water-soluble polymer, it is manufactured as a white amorphous flake that should be dissolved and applied as a dilute aqueous solution.

A variety of successful applications have been made, and the product is available for commercial use. Samples, technical assistance and directions for use may be requested from Technical Service and Development, Dow Chemical Co., Midland, Mich. **(1)**



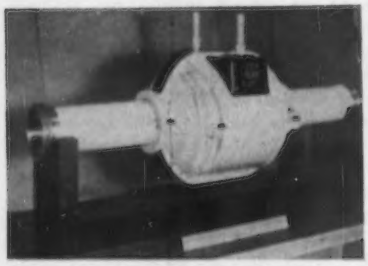
LEVEL CONTROL

Capacitive level senses with electronic controls terminating in air pressure variations which operate a pneumatic diaphragm control valve. Applicable to most non-adhesive chemicals over a temperature range from 500 deg F to —425 deg F. Thermo Instruments Co., Belmont, Calif (2)



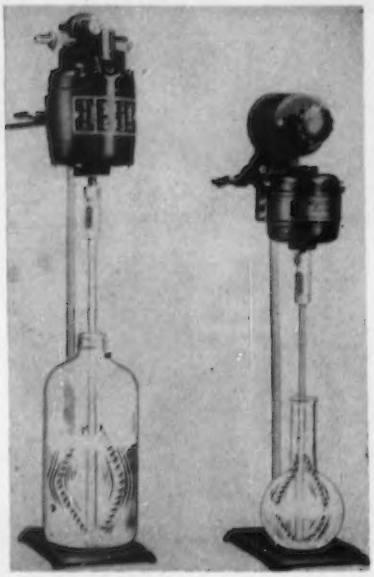
DC MOTORS

"Dynamic response", quick and accurate reaction to any demand for a change in speed or load, is the chief attraction of the "Super T" line of dc motors made by Reliance Electric & Engineering Co., Cleveland, Ohio. Produced in sizes from 20 to 100 hp. (3)



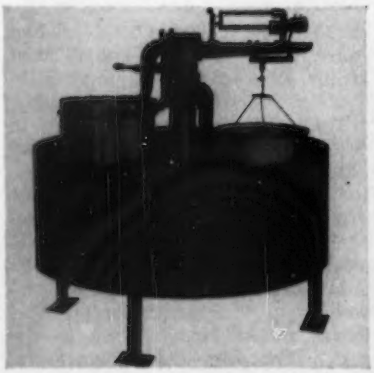
MAGNETIC FLOW METER

This electromagnetic flow meter, designed for 2 to 8-in. lines, will measure the volume flow rate of any liquid of sufficient conductance and velocity. It is unaffected by pressure, viscosity, density or changes in conductivity of the flowing liquid. To find out how it's built and exactly what it can do, circle No. 4 on the reply card opposite p 42, and mail at once. Foxboro Co., Foxboro, Mass. (4)



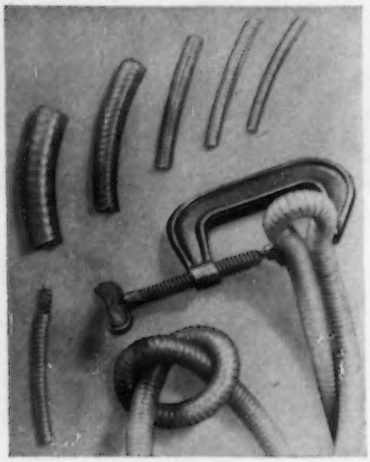
STIRRING

This crazy egg-beater is called "Flexstir" and it will fit into any vessel whose opening is not less than ⅝ in. in diameter. A stainless steel chain on the end of a stainless steel rod does the stirring. Palo Laboratory Supplies, Inc., New York, N.Y. (5)



HEAVY MEDIA TESTING

Heavy media testing machine quickly and accurately permits testing to maintain grade and quality in your plant-size heavy media operation and to maintain efficient separation. Compact unit is easy to operate and a one cu ft sample can be tested for heavy media ratio in a matter of a few minutes. Robert Holmes & Brothers, Inc., Danville, Ill. (6)

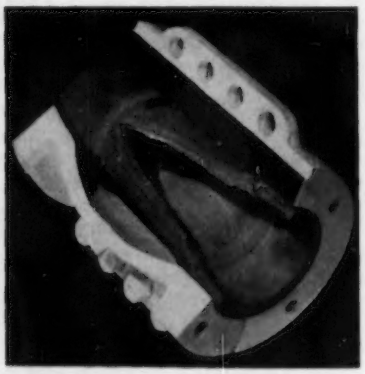


FLEXIBLE PIPING

As you can see "Armourvin" is an extremely flexible industrial piping. It is made of translucent plastic with steel wire imbedded in the wall. It's corrosion resistant, will withstand temperatures up to 70 deg C, and can be manufactured in one continuous piece in lengths up to 2 mi. Inside dia. range from ⅛ to ½ in. Newage International, Inc., New York, N.Y. (7)

HYDRAULIC HOSE AND COUPLING

Joy Mfg. Co., Pittsburgh, Pa., has introduced a new line of hydraulic hose and couplings, tradenamed "Surgepruf", for medium high and high pressure service. Couplings, made to JIC standards, feature a double wedge grip which makes possible assembly on rubber covered hose without skiving. A special slotted bushing makes it possible to retighten coupling on hose without disassembly. (8)



CONTROL VALVE FOR SOLIDS

"Red Jacket Valve" is designed as a control valve for handling solids in suspension, acid slurries and the like. Can be operated pneumatically or hydraulically. The body is cast iron; the

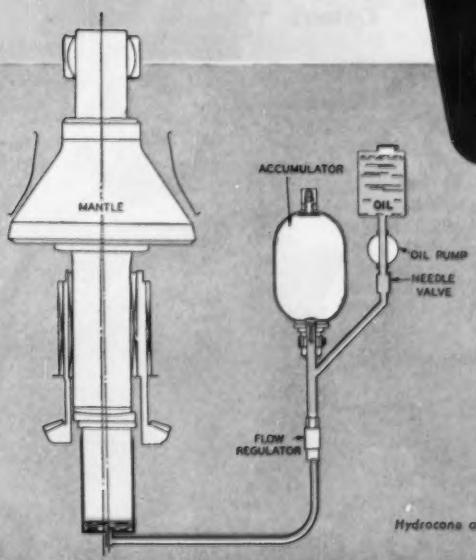
Speed-Set Hydraulic Adjustment Affords

One Man...One Minute Product Control

Quick, Accurate Product Size Adjustment — No dismantling and no auxiliary equipment are required to change from one product size to another. Changing is instantaneous and precise with *Speed-Set* control.

Simplified Compensation for Wear—Compensating for wear on concaves and mantle is equally as fast and convenient. A push of a button on large *Hydrocone* crushers or a move of the hand control on smaller sizes does the job.

Fast Emergency Unloading and Tramp Iron Protection — If crusher stops abruptly because of power failure or other emergency, *Speed-Set* control facilitates fast clearing of crushing chamber.



How *Speed-Set* Control Works

Mainshaft assembly is supported on hydraulic jack. Oil pumped into or out of jack raises or lowers crushing mantle.

When tramp iron enters crushing chamber, oil from jack is forced into accumulator, allowing mantle to lower. Automatic reset returns cone to original setting after tramp material is passed.

For complete information, see your A-C representative or write Allis-Chalmers, Milwaukee 1, Wisconsin. Ask for Bulletin 07B7145B.

A-4478

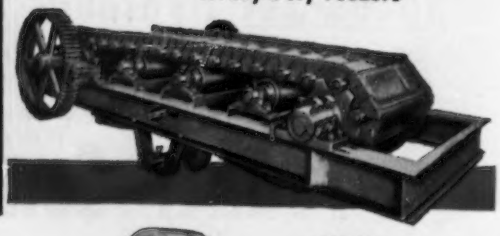
Hydrocone and Speed-Set are Allis-Chalmers trademarks.

ALLIS-CHALMERS

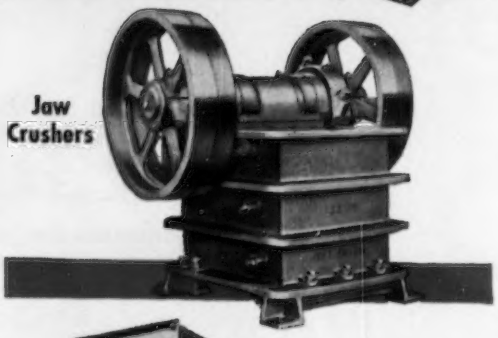
TELSMITH

feeding
coarse crushing
screening
fine crushing
scrubbing

EQUIPMENT FOR MINES

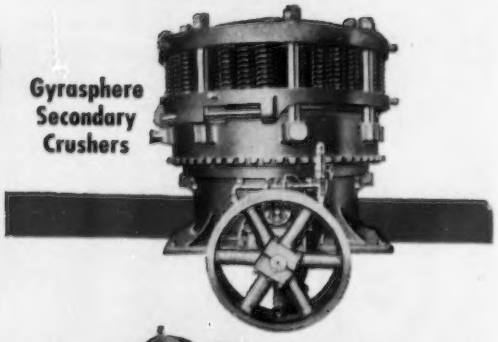


Heavy-Duty Feeders



Jaw Crushers

Vibrating Screens



Gyrasphere Secondary Crushers

Min. 36

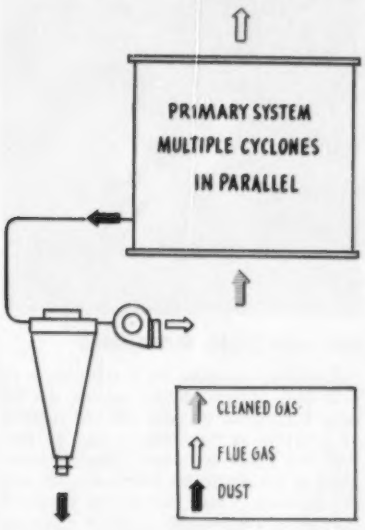
Super-Scrubbers

SMITH ENGINEERING WORKS

502 E. CAPITOL DRIVE **MILWAUKEE 1, WISCONSIN**

Representatives in Principal Cities in All Parts of the World • Cable Address: Sengworks, Milwaukee

sleeve, gum rubber, butyl or neoprene. Available in sizes from one to 24 in. Red Jacket Co., Inc., Pittsburgh, Pa. **(9)**



DUST COLLECTION

A new wrinkle in mechanical dust collectors is the "Paraclone", developed by Aerodyne Corp., Cleveland, Ohio. It differs from conventional systems using a lot of small cyclones in parallel, by having a secondary circuit which keeps the discharge from the small cyclones under constant negative pressure. (Drawing shows general arrangement.) Units are easy to install, maintain efficiency despite changes in gas volume produced. **(10)**

SULPHURIC ACID PLANTS

Substantial increases in capacity from existing contact sulphuric acid plants are said to be possible with a 2-stage exit gas scrubbing process offered for licensing by Olin Mathieson Chemical Corp., Baltimore, Md. This is the Cominco SO_2 Recovery Process for which Olin Mathieson has exclusive licensing rights, plus a modification developed by Olin Mathieson. **(11)**

DIESEL ELECTRIC WAGON CRANE

Industrial Brownhoist Corp., Bay City, Mich., has just delivered the first of the rubber-tired mobile cranes it is now producing. Models come in 25 to 60-ton capacities. **(12)**

PLASTIC TANKS

Atlas Mineral Products Co., Mertztown, Pa., has announced the availability of a complete line of reinforced plastic structures as standard size tanks, stacks and ductwork. To get the facts, try the reply card opposite p 42. **(13)**

TORQUE CONVERTERS

A complete line of "Torcon" torque converters for heavy-duty, off-the-road vehicles and stationary power plants, is now being produced by the Automotive Division of Clark Equipment Co., Jackson, Mich. **(14)**

SUMP PUMP

Pneumatic sump pump built by Schramm, Inc., West Chester, Pa., has high capacity and can be operated by any 105 or 125 cfm compressor. **(15)**

VERSATILE EXCAVATOR

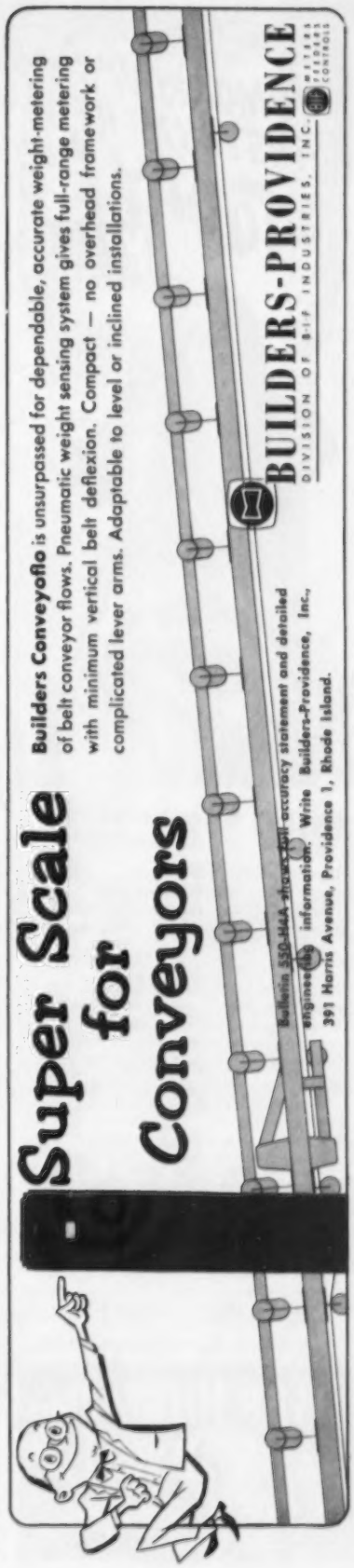
The new Marion 83-M is an all-purpose excavating machine with special features designed to make it a 60-ton lifting crane. The 2-yd shovel features a torque converter, self-cooling swing clutches and air controls. Marion Shovel Co., Marion, Ohio. **(16)**

STEERING BOOSTER

Hydraulic power steering booster made by Vickers Inc., Detroit, Mich., can be factory installed or mounted on vehicles in service. To get compactness in Series S23 boosters, they relocated hydraulic connections and put in a new servo control valve design. **(17)**

FUME CONTROL

Chemurgic Process Corp., New York, N.Y., calls "Siftaire" an "efficient, low-cost process for removing industrial odors and recovering valuable vapors


Super Scale for Conveyors
Builders Conveyoflo is unsurpassed for dependable, accurate weight-metering of belt conveyor flows. Pneumatic weight sensing system gives full-range metering with minimum vertical belt deflexion. Compact — no overhead framework or complicated lever arms. Adaptable to level or inclined installations.
Bulletin 550-H4A shows belt accuracy statement and detailed engineering information. Write Builders-Providence, Inc., 391 Harris Avenue, Providence 1, Rhode Island.
BUILDERS-PROVIDENCE
DIVISION OF B·I·F INDUSTRIES, INC.
PNEUMATIC CONTROLS

WILD T-2 UNIVERSAL THEODOLITE

In arctic cold or tropical heat . . . under all climatic conditions, the universal favorite for triangulation, bridgework and other precise engineering jobs. Known for effortless, high precision operation the world over. The instrument for YOU Today!

You read both circles by microscope (adjacent to telescope) . . . direct to one second. Every reading gives the mean of two diametrically opposite points of the circle, and is therefore free from eccentricity-errors.

The optical plummet makes centering above a ground point an easy and quick operation even on windy days. The telescope with its big field of view is "easy on the eye" and can be transited both ways.

Available accessories include battery box for night work, traverse targets, Invar Subtense Bar for optical distance measurement.

•

Choose WILD instruments for ease of operation, speed and accuracy.

•

Write or phone for Booklet MJ 2

•

Full Factory Service by Specialists

WILD HEERBRUGG INSTRUMENTS INC.

MAIN & COVERT STS., PORT WASHINGTON, N. Y.

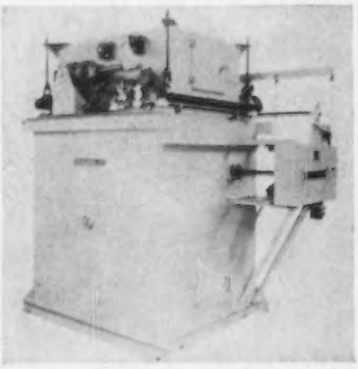
PORt Washington 7-4843

E&MJ NEW PRODUCTS DIGEST

from plant exhausts." Key to the process is use of activated carbon which can be regenerated cheaply. Use reply card for details. **(18)**

WIRE ROPE CUTTING

Wire rope of all sizes can be cut quickly and easily without deforming or unraveling with this reinforced resinoid wheel. Circle No. 19 for detailed information. Norton Co., Worcester, Mass. **(19)**



BATCHING SCALE

The new batching scale of Richardson Scale Co., Clifton, N.J., is designed for weighing hot materials in high tonnage quantities. Key features of this otherwise standard Richardson automatic scale include heavy-duty construction, extra-large weigh hopper (25 cu ft), a dust-tight housing, separately housed controls. **(20)**

PORTABLE COMPRESSOR

Two-wheeled portable compressor, with a capacity of 125 cfm Model WH-125, is a two-stage water-cooled compressor drive by either gasoline or diesel industrial-type engine which operates at modern speed. Complete details are available from the manufacturer, Gardner-Denver Co., Quincy, Ill. **(21)**

BIT GRINDING MACHINES

Grinding machine for sharpening rock drill bits, Model LSB-62, grinds the bit edge lengthwise because the old method of grinding at an angle is said to give rise to easy breakage. Desired tool angle is set easily by thumb-screws, and the measure is read directly on a pair of indicators. Feed depth is set by a special screw. Machine is pneumatically driven and can be used by untrained personnel. Weight is about 50 lb. Copco Eastern, Paterson, N. J. **(22)**

PORCELAIN CYCLONE

Dorr-Oliver Inc., Stamford, Conn., has available Type P50 DorrClone capable of separations in the 10 to 20 micron range on non-abrasive, relatively fine feed. Constructed entirely of porcelain with a cone 50 mm in dia, this wet cyclone will operate at pressures up to 80 psi with a maximum flow of 30 gpm. **(23)**

POCKET pH METER

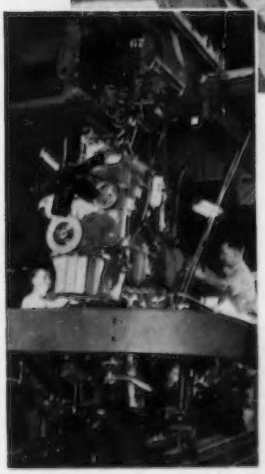
Completely self contained in a bakelite 3x5⅞x2½-in. case, this pocket-size pH meter with probe unit permits instant on-the-spot pH determinations anywhere. Batteries provide up to 1300 hr operation. Analytical Measurements Inc., Chatham, N. J. **(24)**

USE REPLY-CARD OPPOSITE P42

CUSTOM BUILDING

...the Autocar Feature of Most Benefit to You

Your toughest hauls become easy when you use Autocars, because Autocars are custom-built to meet them. We help you select the proper components for your Autocar . . . the engine, frame, transmission, rear, etc., which will function best for you. A truck built under this system performs on an entirely different plane. Its useful life will be longer, its maintenance will cost less, and you will have to look twice at the figures before you will believe its ton-mile hauling efficiency.



Your Autocar starts down the assembly line with a tag specifying exactly the components recommended for your hauling conditions.

AUTOCAR TRUCKS

AUTOCAR DIVISION OF THE WHITE MOTOR COMPANY, EXTON, PA.

Autocar trucks are sold and serviced throughout the world

Send for the Autocar Fact Booklet. It tells you about custom building and many other exclusive Autocar features.

Autocar Division of The White Motor Company, Exton, Pa.
Please send me the Autocar Fact Booklet.

Name and Title_____

Firm Name_____

Address_____

Type of Operation_____ No. of trucks in fleet_____

26-C

ONE NO. 80 SCRAPER DOES IT ALL!

The Caterpillar No. 80 Scraper in the picture removed nearly all the clay overburden from this 100-foot-deep pit. It was then used to move iron ore to the washing plant of Hodge Mining Company at this operation 7 miles north of Canton, Ga. Cycle time was 8½ to 9 minutes over a haul distance of 2000 feet, involving extremely stiff grades out of the pit.

Maneuverability in these cramped quarters is a "must." With its ball-and-socket front axle, and sharp turning ability, the No. 80 Scraper is just the rig for this job, according to John W. Hodge, owner.

Even in mucky clay, the No. 80 loads fast, with a live, "boiling" action. The load is cradled low for stability in rough going, and big tires give excellent flotation. Absence of overhead structure permits good operator vision, and presents an easy "target" for shovel loading. The No. 80's capacity is 20 heaped yards (23 with top extensions). It unloads fast and even, thanks to the positive ejection system that controls the rate of spread and sweeps the bowl clean of even sticky materials.

The versatile No. 80 Scraper, teamed with the Caterpillar D8 Tractor, may be the rig to cut costs in *your* mining operation. Or one of the other CAT* Scrapers for track-type and rubber-tire tractors with capacities from 4.5 to 25.5 yards. Your Caterpillar Dealer will help you select the scraper that's most profitable for *you*. And he'll stand back of his products with prompt, dependable service and genuine Caterpillar replacement parts. Ask him for a demonstration right on your own job today.

Caterpillar Tractor Co., Peoria, Ill., U.S.A.

CATERPILLAR*

*Both Cat and Caterpillar are registered trademarks—®

**NAME THE DATE...
YOUR DEALER
WILL DEMONSTRATE**

For Your Files

This informative manufacturers' literature is free unless otherwise specified. To obtain bulletins circle their numbers on card below and mail.

DRILLS. Acker Drill Co., Scranton, Pa. has a raft of information for you on their Models LD and LLD portable core drills. The LD features a compact unit power plant, built-in cathead hoist, positive displacement pump, 3-speed transmission and rotary drill head with hand-lever feed. Model LLD is a lightweight unit without pump, hoist or 3-speed transmission. **(51)**

APPRENTICESHIP PROGRAMS. "Setting up an Apprenticeship Program" details all the steps for getting your own program started. This very useful pamphlet is a free Government publication issued by the Department of Labor. **(52)**

AGGLOMERATION. This is a hot topic these days and Dravo Corp., Pittsburgh, Pa. is right on top of it with its Dravo-Lurge sintering and pelletizing machines. The features of this German method are discussed in a 4-page folder. **(53)**

PAYLOADER ATTACHMENTS. "Useful Attachments for 'Payloader' Tractor Shovels" is offered by Frank G. Hough Co., Libertyville, Ill. Included are sixteen attachments that are available to adapt these versatile tractor-shovels to many tasks in addition to bulk materials handling and earth-moving. **(54)**

DRILLING. Finest case we've seen for long-hole percussion drilling, showing when and how it may be employed, is contained in a first rate bulletin published by Gardner-Denver Co., Quincy, Ill. This is a **must** for mining engineers. It's like a section out of a handbook. **(55)**

CYCLONES. How they're made; how they work; how to use them—fill this 16-page bulletin with a lot of worthwhile material for your technical file. Heyl & Patterson, Inc., Pittsburgh, Pa. **(56)**

COLLOIDAIR SEPARATORS. The 8-page catalog, 'Colloidair System for Recovery of Suspended Materials for Waste Water Treatment, Etc." published by Bulkley, Dunton Processes, Inc. New York, N.Y. features factual data on efficiency of the Colloidair process, flowsheets of typical installations, description of operating principles, and an analysis by types of industries of various applications for Colloidair systems. **(57)**

ENGINE-GENERATOR SETS. Bulletin on "Custom Built" engine-generator sets describes and illustrates seven engine models from 60 to 675 hp with generators capable of producing from 50 to 350 kw. LeRoi Division, Westinghouse Air Brake Co., Milwaukee, Wis. **(58)**

DRILL JUMBOS. Bulletin J-100 describes straight and offset hydraulic booms, hydraulic lift and swing cylinders, and hydraulic pumps, for mounting on any suitable chassis or vehicle. Also described are completely equipped hydraulic drill jumbos for rail service, the self-propelled Gardner-Denver Mobiljumbo with remote drill controls, roof-pinning jumbos and tractor-mounted jumbo units complete with air compressor. Gardner-Denver Co., Quincy, Ill. **(59)**

VARIABLE SPEED DRIVE. Bulletin 497 describes T. B. Wood Sons' Co.'s wide-range belt variable speed drive. Shows how to design and select drives for 1- to 20-hp motors. And there you are! **(60)**

ENGINEERING SERVICES. The engineering division of Vitro Corporation of America stands ready to handle your new plant problems from design through process engineering, architecture and construction. What they have done and what they can do for you are ably described in this handsome brochure. **(61)**

CAST MONEL. A technical booklet describing the engineering properties of cast Monel has just been issued by International Nickel Co., Inc., New York, N.Y. **(62)**

HYDRAULIC CRANE. An 8-page illustrated bulletin (AD-2253) describing indoor - outdoor hydraulic crane, made by Austin-Western Co., Aurora, Ill., includes specifications, performance data, diagrams on working ranges, manual boom extensions, minimum aisle widths for turns, etc. **(63)**

PUMPS. "Turbine Pumps for Industry," is an 8-page bulletin (No. 735-1) which describes and illustrates the latest models of vertical turbine pumps manufactured by A. O. Smith Corp., Los Angeles, Calif. Shows characteristic curves and details principal components. **(65)**

HOT METAL CARS. This 12-page catalog opens with the statement that, "More than 400 Treadwell mixer-type hot metal cars have been placed in service." You then find out why these conveyances are so popular when it comes to carrying molten metal around and about. M. H. Treadwell Co., Inc., New York, N. Y. **(66)**

PLANT MAINTENANCE. Johns-Manville, New York, N.Y. has issued a new edition of "Good Operating Practices," an illustrated 12-page brochure containing 101 suggestions for maintaining plant buildings and equipment with latest recommendations for getting best service out of insulations, packings, refractory products, roofing and friction materials. **(67)**

DUST CONTROL. Neatest flank attack since Stonewall Jackson at Chancellorsville is Bulletin No. 3 published by Mechanical Industries, Inc., Pittsburgh, Pa. It opens with technical discussions and drawings of a variety of cupola dust control systems. The author then rejects all these systems on the basis

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D8 Tractor, may be the rig to cut costs in *your* mining

E&MJ NEW PRODUCTS DIGEST

of costliness, power consumption or complexity. He then presents a simplified and economical approach to the problem of collecting cupola dust "dry." (68)

I-H PRODUCTS. Complete line of International industrial power products, 73 in all, is described in a 48-page catalog by International Harvester Co., Chicago, Ill. (69)

CYCLONES. Bulletin No. 121 does a fine job in 12 pages of illustrating four basic model cyclones and describing new features of molded pure gum replaceable lining and integral two stage cyclindrical design. Contains informative data on role of cyclones in classification and presents full details of specific applications of each model with varied objectives. Equipment Engineers, Inc., San Francisco, Calif. (70)

DIFFUSION PUMPS. A new catalog describing its complete line of diffusion pumps is available from Maresco Equipment Corp., Newton Highlands, Mass. Catalog gives the characteristics of each pump, including pumping speeds, operating pressures, blank-off pressures, and forepressure limits. Operating charts on throughput and inlet pressures, as well as photographs and drawings, are included. (71)

DIESEL ENGINES. A 12-page bulletin 235, describing Nordberg 29-in. bore stationary and marine diesel engines which range in size from 4500 to 10,800 hp is announced by Nordberg Mfg. Co., Milwaukee, Wis. Points up the savings from use of straight run or cracked residual fuels. Type TS-29 engine operating as a Duafuel unit permits even greater savings where gas is abundantly available and inexpensive. (72)

SCRAPER HOISTS. Full line of air and electric hoists for handling bulk materials of all types is described in a comprehensive catalog from Ingersoll-Rand Co., New York, N.Y. Outstanding features of each type and size are carefully outlined along with specifications, capacities, sizes, symbols and accessories available. Single, double and triple construction hoists as well as drum lengths, frame construction and motor types are discussed and shown in line drawings. Tables cover weights of materials and rope pull required for drawing cars up grades or inclined tracks. (73)

STITCH IN TIME. A portable kit provides magnetic particle testing which reveals flaws or cracks in ferrous metal vessels of all kinds including tanks, receivers, pipe, pump casings. One simple operation tells you whether repair or replacement is needed before you are hip-pocket deep in trouble. North American Philips Co., Inc., Mt. Vernon, N.Y. (74)

SCIENTIFIC INSTRUMENTS. This fat, 62-page book is full of information on such instruments as pH electrometers, nephelometers, titrators, spectrophotometers, colorimeters, photo-fluorometers. Brief description of principles and practices in using these gadgets are very illuminating. (We learned that nephelometry is the science of measuring light reflected by the finely divided particles of a suspension.) Coleman Instruments Inc., Maywood, Ill. (75)

TRACTORS. A 28-page folder in color, describing and illustrating features of the 208-hp rubber-tired tractor built by LeTourneau-Westinghouse Co., Peoria, Ill. uses photos, diagrams and charts, the folder to show how the unit's range of speeds cuts minutes from the work cycle, and reasons why the machine requires low maintenance and few repairs. (76)

FLUID COUPLINGS. Bulletin No. 144-D, giving complete installation and performance data on fluid couplings, has been released by Twin Disc Clutch Co., Racine, Wis. Complete with diagrams and drawings, it shows the ease of applying twin disc fluid couplings on any type industrial equipment, powered by any type electric motor or internal combustion engine from 3.4 to 850 hp. (77)

ROOF CONTROL DRILLS. Specification, description and advantages of a number of models of self-contained units for doing your roof bolting are described in this bulletin from J. H. Fletcher & Co., Huntington, W. Va. (78)

TUNGSTEN. Sylvania Electric Products, Inc., New York, N.Y., has published an enlightening brochure devoted to the manufacture, properties, and use of tungsten. Of unusual interest is a colorful flow-chart which shows how tungsten is manufactured from ore to finished products. (79)

FROTH FLOTATION. An outstanding contribution to ore dressing is "Froth Flotation," published by American Cyanamid Co., New York, N.Y. A well-organized, comprehensive study, it goes into properties of various frothers, comparison of frothers, principles and applications of flotation machines. Also includes a first-rate bibliography on the subject. (80)

FILTER PRESSES. "A Guide to Better Filtration" is what T. Shriver & Co., Inc., (Harrison, N.J.) calls its Catalog No. 55 on Shriver filter presses. The 28-page booklet gives you a clinical examination of these units and contains in addition a lot of valuable information for making filter calculations. (81)

PUMPS. Useful tables by the pageful abound in this Catalog No. 953 on Hydroseal pumps, issued by Allen-Sherman-Hoff Pump Co., Wynnewood, Pa. Excellent two-color sections help illustrate how the Hydroseal pump works and what its advantages are. (82)

ARMORED MOTORS. Full-color, 4-page publication GEA-4654C, describing armored motors (dc types MD and MDP, 600 series) is available from General Electric Co., Schenectady, N. Y. Provides information on performance and maintenance features, horsepower ratings and mechanical data. Diagrams and photographs illustrate various applications of armored motors. (83)

RUST PREVENTION. An outstanding treatise on rust prevention is the 1955 general catalog of Rust-Oleum Corp., Evanston, Ill. The 98 color chips of Rust-Oleum products should brighten up your rust-busting activities. Included are complete instructions for surface preparation and application with ways and means to make substantial savings. (84)

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(PLEASE GIVE THIS ADVERTISEMENT TO YOUR BLASTING FOREMAN)

IGNITACORD

will ignite every fuse in the round

while your Blaster is far, far away!

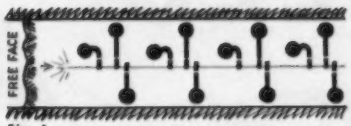


Fig. 1 **FIRING STOPE ROUNDS**

Fig. 1 shows a stope drilled with three rows of uppers, the fuse from each hole being connected to a single line of Ignitacord. Note that the center holes will fire before the two corresponding rib holes.

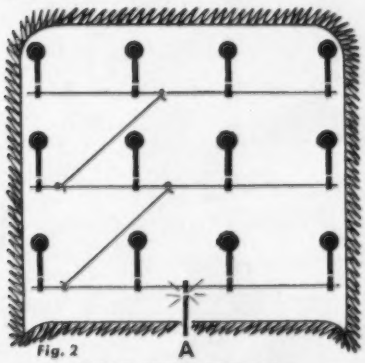


Fig. 2 **FIRING STOPE ROUNDS**

In *Fig. 2* the fuses extending from the horizontal breast holes are connected to four lines of Ignitacord at regularly spaced intervals. Jumper lines connect the horizontal lines, and the Igniter cord is activated by a length of Safety Fuse at Point A.

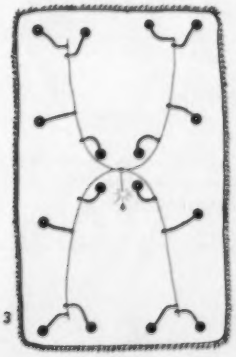


Fig. 3

FIRING DEVELOPMENT ROUNDS

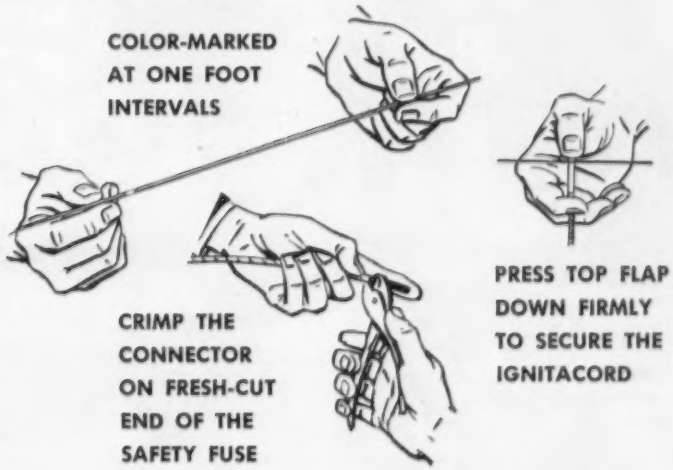
Fig. 3 illustrates an Ignitacord hook-up arranged to fire the cut holes in one group, and the remaining holes in the proper order of rotation. Ignitacord lines should always be kept separated enough to avoid cross ignition.

With Ignitacord* you can have controlled rotation spitting of safety fuse in a round. Here are some of the advantages for you:

Less Hazard. The Blaster lights the Ignitacord at one point. This point can be at the face, if the path of retreat is clear; or at a remote point if the path is difficult, such as when shooting a raise.

Easy Figuring. All fuses in the round are cut to uniform length. There is no need for trimming, since accurate time delay is governed by the length of Ignitacord between holes.

*Sold on the West Coast under the name of SPITTERCORD by the Coast Manufacturing and Supply Co., Livermore, California.


COLOR-MARKED AT ONE FOOT INTERVALS
PRESS TOP FLAP DOWN FIRMLY TO SECURE THE IGNITACORD
CRIMP THE CONNECTOR ON FRESH-CUT END OF THE SAFETY FUSE

Ignitacord burns progressively with a short hot external flame at the zone of burning. Two types are available. Type A burns at the rate of 8 to 10 seconds per foot. Type B burns at the rate of 16 to 20 seconds per foot. Each type is packed on 100-ft. spools.

Ignitacord Connector is a metal shell containing an ignition charge. The shell is crimped on the end of the fuse. Ignitacord is pressed into a slot near the top, and this top is pressed down firmly against it. Connectors are supplied in packages of 100.

See your Explosives Supplier or write to

THE ENSIGN-BICKFORD COMPANY

SIMSBURY, CONNECTICUT

Manufacturers of Primacord® Detonating Fuse, Safety Fuse, Quarrycord, Blasting Accessories — Established 1836

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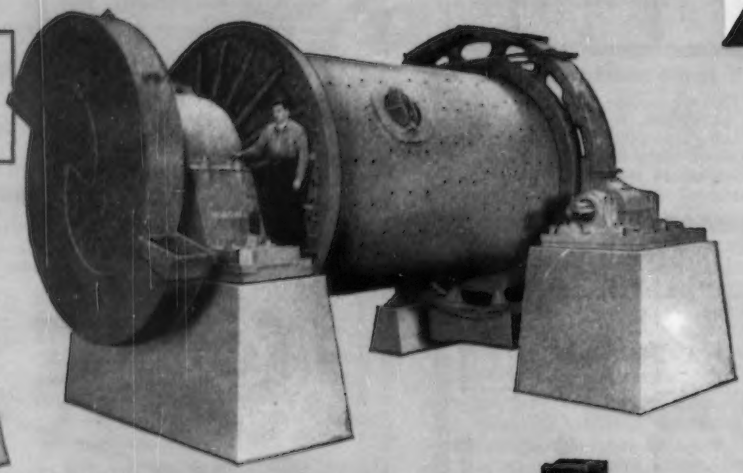
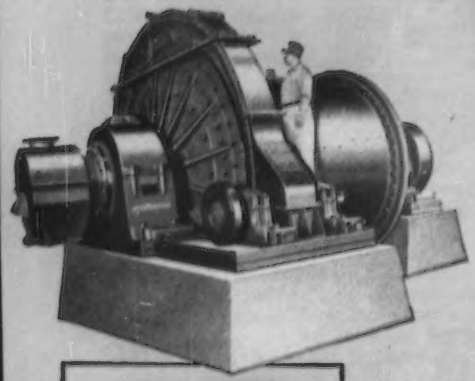
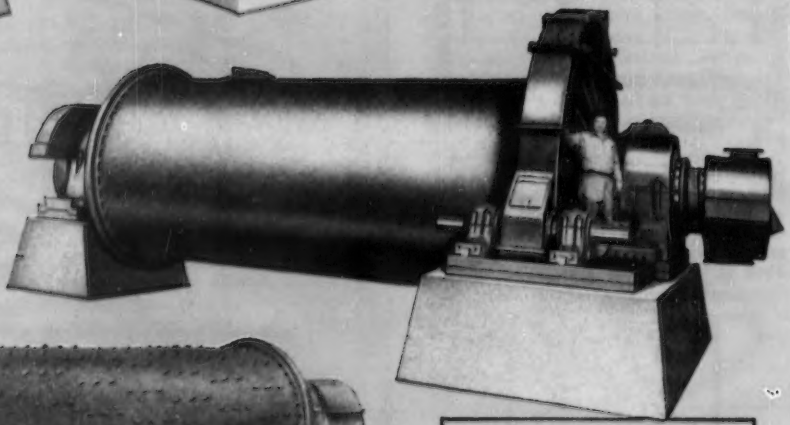
NORDBERG GRINDING MILLS



NORDBERG 10'-8" x 17' Wet Grinding Mill showing scoop feeder.



NORDBERG 9'-6" diameter x 11' long Dry Grinding Mill.



NORDBERG 9'-6" x 24' Wet Grinding Pebble Mill for non-ferrous milling.

NORDBERG 8'-6" x 36' two-compartment clinker Grinding Mill manufactured for a large cement plant.

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MORE than half a century of progressive engineering achievement, combined with quality production in modern manufacturing facilities, have won for Nordberg a foremost position in the field of heavy machinery manufacture.

This is evidenced by the universal acceptance which Nordberg Machinery has received by most of the Mining and Mineral processing industries throughout the world.

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Nordberg manufactures Ball, Tube, Rod and Compartment Mills, of grate, overflow and peripheral discharge types for wet or dry grinding service, in sizes ranging to 13′-0″ diameter, and in lengths to 40′-0″

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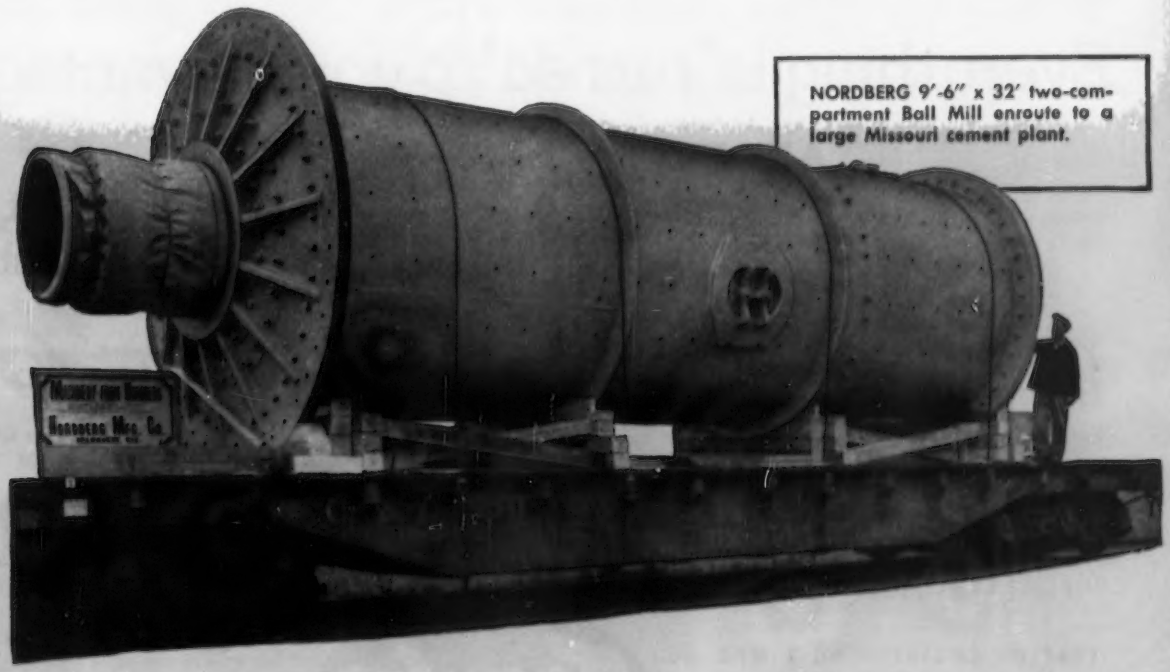

NORDBERG 9′-6″ x 32′ two-compartment Ball Mill enroute to a large Missouri cement plant.

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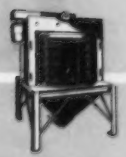

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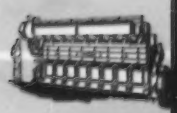

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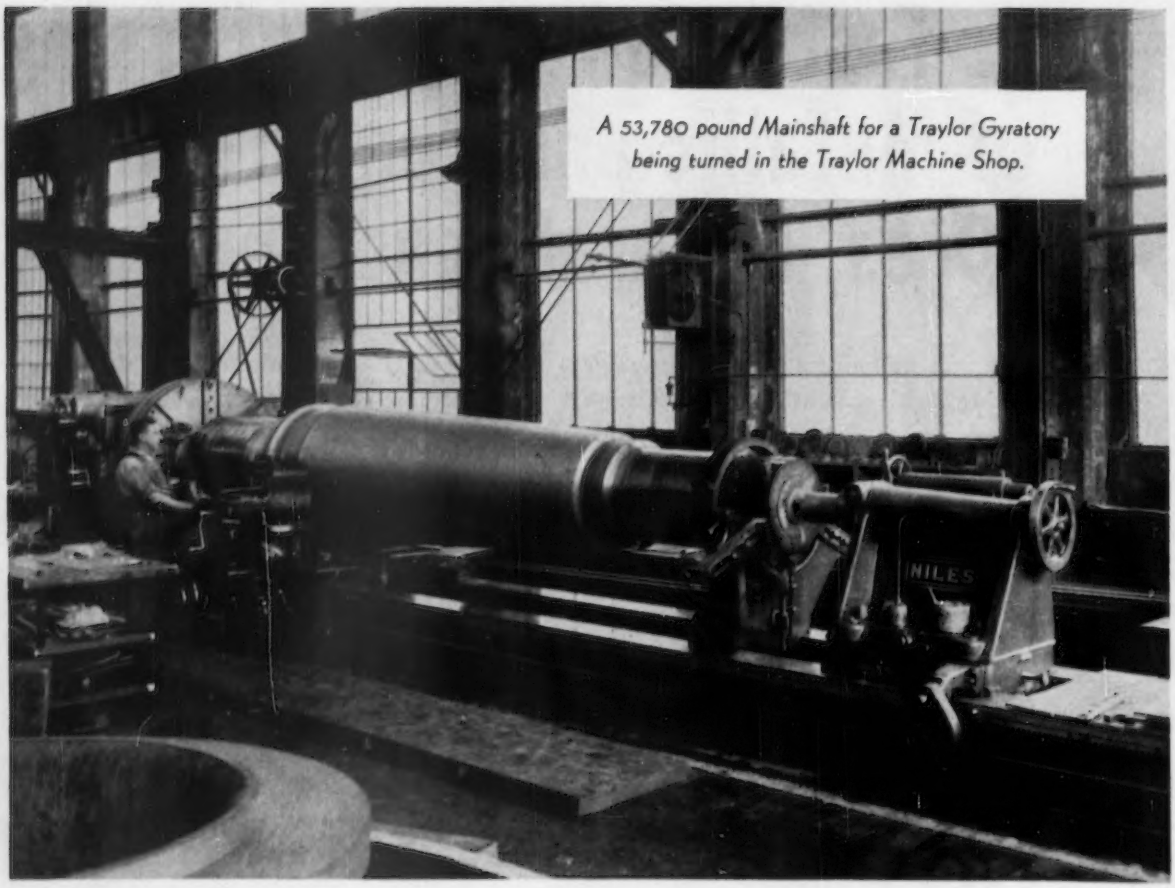

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TIMKEN® interchangeable rock bits let you switch bit types without switching drill steels

Dozens of different TIMKEN® multi-use and carbide insert bits fit the same steel

YOUR drillers can change Timken® interchangeable rock bits quickly, easily, right on the job. They won't waste valuable drilling time going after a different set of drill steels every time a different bit type is needed. They'll simply unscrew one type of Timken bit and screw another right on the same steel. And they can make this change in one minute flat!

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Both Timken carbide insert and multi-use bits are made from electric furnace Timken fine alloy steel. Both have special shoulder unions that keep drilling impact from damaging threads.

Our rock bit engineers are experts at cutting drilling costs. Maybe they can save you some money? Drop them a line. There's no obligation. Write: The Timken Roller Bearing Company, Rock Bit Division, Canton 6, Ohio. Cable address: "TIMROSCO".

WHERE YOU CUT COSTS WITH TIMKEN MULTI-USE BITS

Most economical for ordinary ground. With correct and controlled reconditioning, they give lowest cost per foot of hole when full increments of steel can be drilled.

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Give highest speed through hard, abrasive ground. Also most economical for constant-gage holes, small diameter holes, very deep holes.

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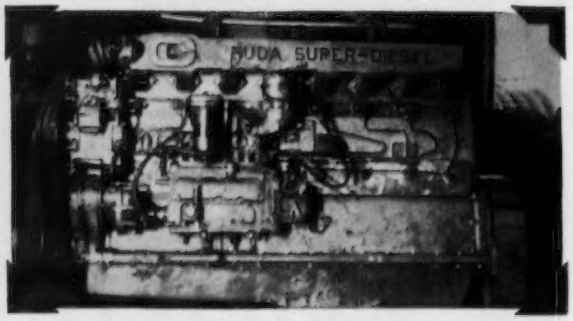
STANDARD ENGINEER'S REPORT

DATA

LUBRICANT	RPM Delo Oils
UNITS	21 Buda diesel engines
OPERATION	Hauling ore
CONDITIONS	Heavy duty — 8-15% grades
PERIOD	6 years
FIRM	Bagdad Copper Corp., Bagdad, Arizona

No stuck rings in 21 engines in 6 years hauling ore!

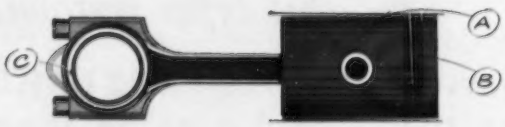
HAULING 22-TON LOADS up 8 to 15% grades out of the Bagdad Copper Corp. open-pit mine, 21 Buda diesels have had no stuck rings, no clogged ring grooves since using RPM DELO Special Lubricating Oil for



the last 6 years. Engines operate 2 shifts a day, 6 days a week in heavy abrasive dust. Torn down after 7000 hours, all parts in the engine above were exceptionally clean and all bearings were good.

BIGGEST OFF-HIGHWAY TRUCK IN THE WORLD (above) was recently built for Bagdad Copper Corp. It weighs 96,000 pounds, hauls 75 tons. RPM DELO Special Lubricating Oil was also selected for its two 350 H.P. supercharged Buda diesels because of the excellent service Bagdad has had from this oil.

How RPM DELO Oils keep engines clean and prevent wear



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B. Anti-oxidant resists deterioration of oil and formation of lacquer...prevents ring-sticking. Detergent keeps parts clean, helps prevent scuffing.

C. Special compounds stop corrosion of any bearing metal, and oil foaming in both wet and dry sump engines.

There is an RPM DELO Oil to meet every heavy-duty engine operating condition.

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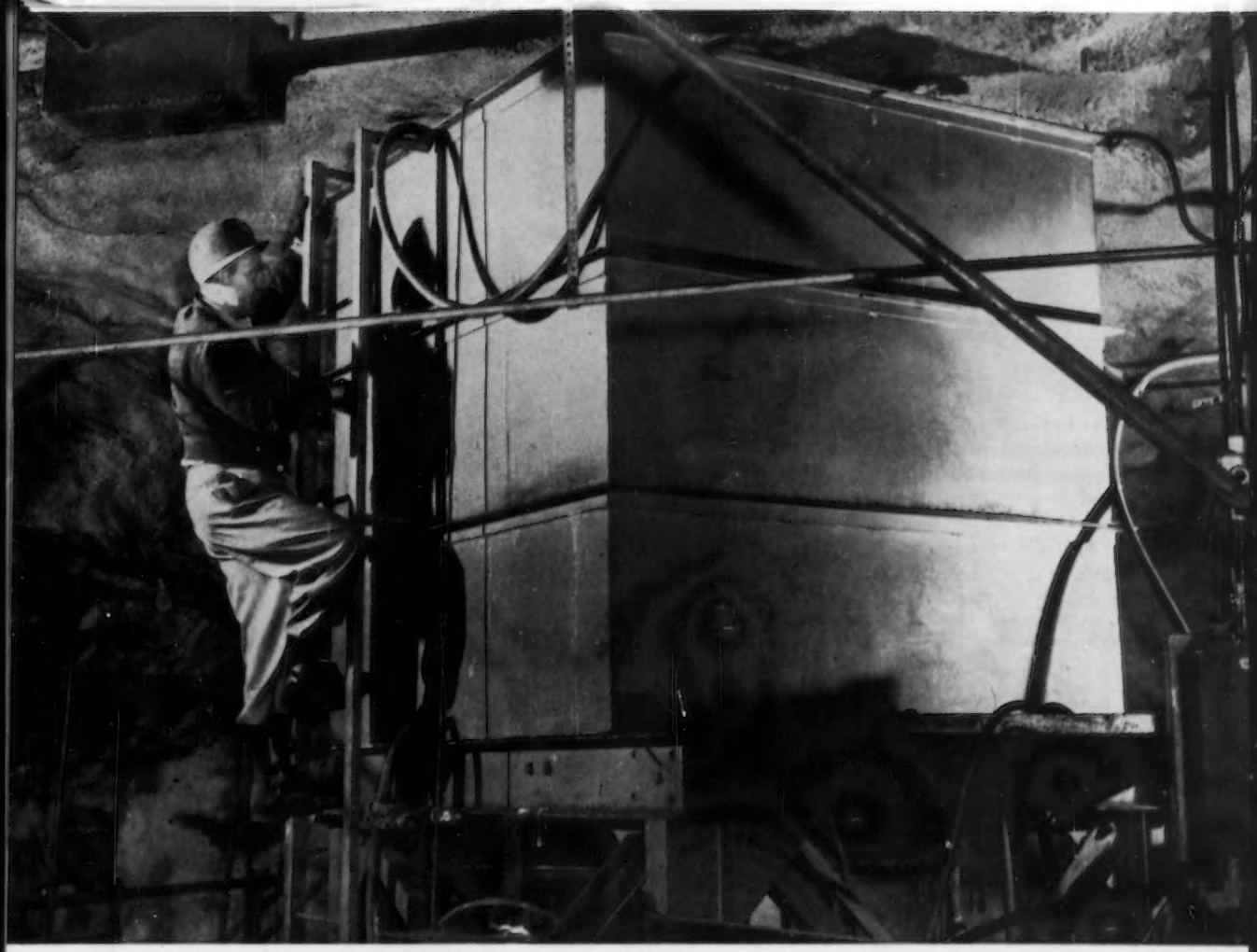

Mill Chief J. G. Craig climbs a ladder to inspect one of the Stainless Steel tanks used for storage of copper sulphate solution.

20% Copper Sulphate Solution stored in tanks of Stainless Steel

TO HANDLE a highly corrosive 20% copper sulphate solution, Empire Zinc Division of The New Jersey Zinc Company installed Stainless Steel storage tanks at its Gilman, Colo., operation more than three years ago.

Here again Stainless Steel has demonstrated its superior corrosion resistance. The tanks have required no replacement or maintenance, and officials say they expect them to last at least 10 years.

The copper sulphate solution is stored at a temperature of 120° F. From the Stainless Steel tanks, it is fed to the flotation circuit where the values are separated from each other and from the gangue.

See The United States Steel Hour. It's a full-hour TV program presented every other week by United States Steel. Consult your local newspaper for time and station.

This is only one of hundreds of jobs Stainless Steel is handling in the mining and recovery of metals. As chemical recovery methods become more widely used, Stainless will play an even more important part, for it has proved itself in both the chemical and mining industries.

Whenever you're looking for long, trouble-free life in spots where corrosion and abrasion take their toll, think of Stainless Steel. And for finest performance, be sure service-tested USS Stainless Steel is used.

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COLUMBIA-GENEVA STEEL DIVISION, SAN FRANCISCO · NATIONAL TUBE DIVISION, PITTSBURGH
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SPECIAL SECTIONS

UNITED STATES STEEL

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From the beginning of the current spectacular uranium developments in Colorado, Utah and other Western states, Sprague & Henwood, Inc. has placed its personnel and equipment, fully and competently, at the disposal of both Government agencies and private mining interests.

As a result of this prompt action, backed by a 70-year record of world-wide experience, we have been awarded contracts for many thousands of linear feet of

EXPLORATION DRILLING

in all of its phases, including

Dry-Hole Drilling with Air
using roller and other-type bits,

Non-Core Drilling, with Air or Water
using either diamond or other-type bits, and

Diamond Core Drilling
with Oriented diamond bits.

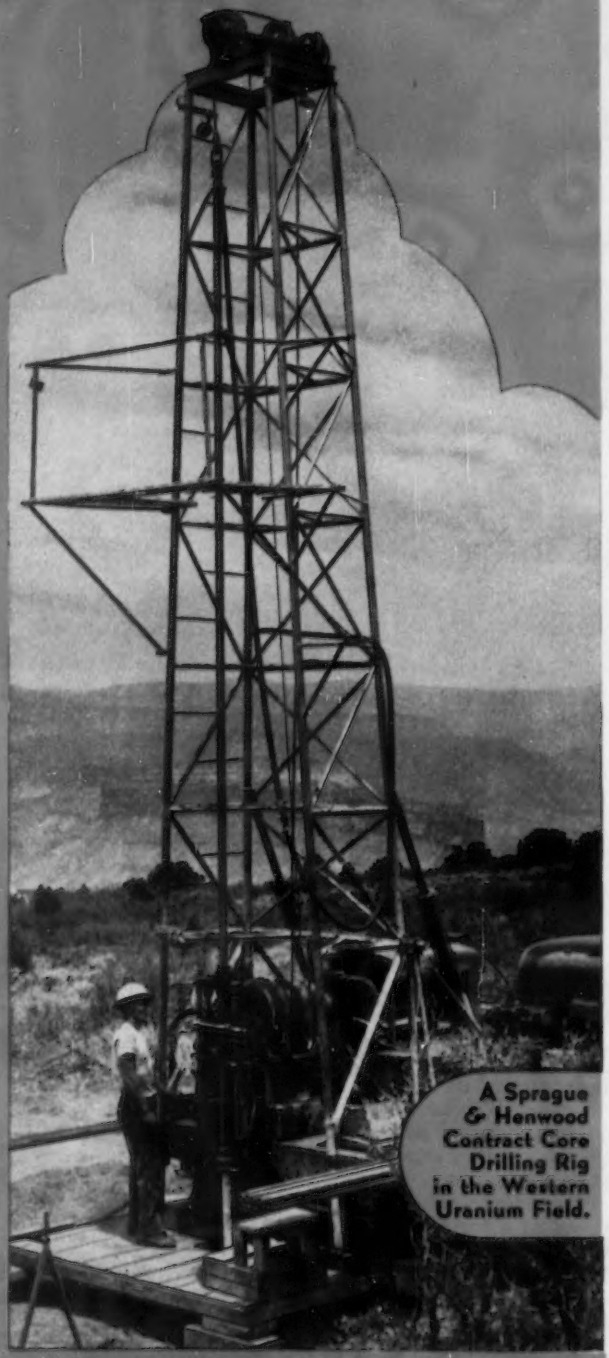
All contracts, except those presently engaged upon have been satisfactorily completed. At present we are busily engaged but, having moved many of our best operators and drilling rigs into the area, are prepared to handle new contracts promptly and efficiently.

A new branch office and shop has been established on the Fruita Highway, near Grand Junction, Colo., to help provide the best possible service throughout the Western uranium field. For quick action, telephone Robert R. Carver, Manager, at Grand Junction 834. He knows the answers to most drilling problems through personal experience.

Sprague & Henwood, Inc.
Scranton 2, Pa.

New York Philadelphia Pittsburgh
Grand Junction, Col. Buchans, Newfoundland

Leading Manufacturers, also, of High-Speed Core Drilling Machines, "Oriented Diamond Bits" and complete accessory equipment for Core Drilling and Soil Sampling. Illustrated catalogs mailed promptly on request.



A Sprague & Henwood Contract Core Drilling Rig in the Western Uranium Field.

The Sun never sets on Sprague & Henwood's Contract Diamond Core Drilling Operations

Cyanamid REAGENT NEWS

"ore-dressing ideas you can use"

Now Available

Mineral Dressing Notes No. 21

Froth Flotation

One glance at the Table of Contents tells why this comprehensive, 24-page, current basic summary of froth flotation should be among your everyday reference texts. The extensive bibliography of literature references is in itself invaluable since it lists principal flotation patents as well as technical articles.

Copies of Mineral Dressing Notes #21 were sent to all those on our technical mailing list. But mailing lists are difficult to keep accurate and complete. So, if you have not received your copy, may we suggest that you drop us a note requesting one or use the handy coupon below.

AMERICAN CYANAMID COMPANY
Mineral Dressing Department
30 Rockefeller Plaza, New York 20

NAME_____

TITLE_____

COMPANY_____

ADDRESS_____

AMERICAN Cyanamid COMPANY

MINERAL DRESSING DEPARTMENT

30 ROCKEFELLER PLAZA, NEW YORK 20, N.Y.
Cable Address — Limenitro, New York

NORTH AMERICAN CYANAMID LIMITED
Royal Bank Bldg., Toronto 1, Ontario, Canada
CYANAMID DE MEXICO, S. A.,
Apartado No. 26012, Mexico 12, D. F., Mexico

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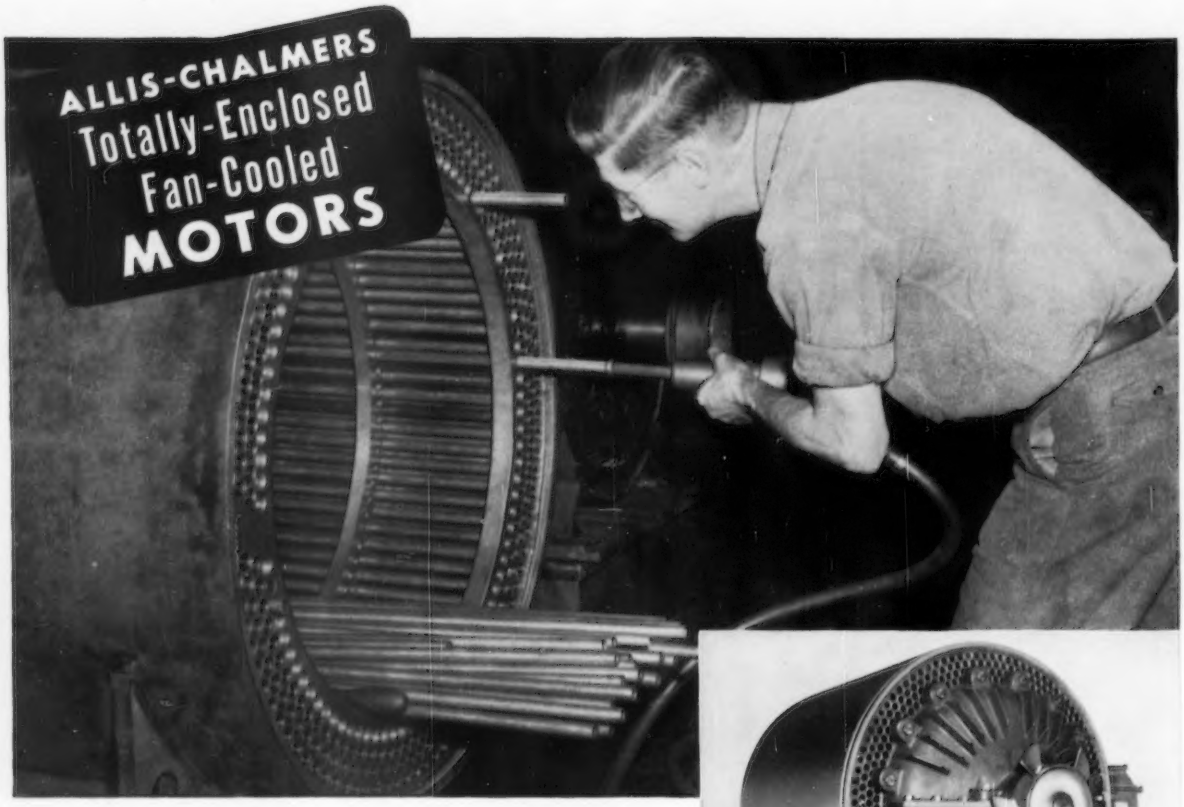
Printed in U. S. A.



3600-rpm explosion-proof motor with fan housing removed to show unidirectional fan.

These heat exchanger tubes

Protect this motor from dirt and corrosion

COOLING AIR is carried through the heat exchanger tubes with sufficient velocity to expel practically all kinds of dirt. If oily or sticky dirt should cling, tubes can be ramrodded clean on the spot in a few minutes because tubes are straight and tube ends are exposed. Also, the tubes are distributed uniformly around the perimeter of the stator yoke and along its full length — cooling all parts of the motor evenly.

Choice of Corrosion-resistant Materials

You can lick corrosion with this motor, too. Tubes are available in a variety of materials to meet practically any corrosive atmospheric condition. Allis-Chalmers tube-type motors have long and successful experience in such difficult applications as caustic plants, refineries and petrochemical plants, power plants with fly ash problems and many others.

Get Complete Information

Next time you need a motor for a dirty or corrosive location or for outdoor operation in all kinds of weather, call your Allis-Chalmers District Office. Get complete information on Allis-Chalmers tube-type totally-enclosed, fan-cooled and explosion-proof motors. Or write Allis-Chalmers, Milwaukee 1, Wisconsin, for Bulletin 51B7149. Available in ratings on frames larger than NEMA 505 up to 3000 hp.

A-4559

ALLIS-CHALMERS

Royal Bank Bldg., Toronto 1, Ontario, Canada
CYANAMID DE MEXICO, S. A.,
Apartado No. 26012, Mexico 12, D. F., Mexico
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Correo 11, Santiago, Chile
G. B. O'MALLEY, MALCOLM GLEN,
377 Little Collins St., Melbourne C. 1, Australia
Printed in U. S. A.

DRAWPOINT LOADING WITH EIMCOS

Drawpoints can, with few exceptions, be used in any mining system. This economical production method is gaining in popularity and has numerous advantages in lower costs, higher production and greater safety.

Eimco has been able to reprint some of the numerous articles from mining journals and has gathered much original material. This information is now available in printed form.

Write for the L-1017 series of publications for information on Eimcos in drawpoint loading.

THE EIMCO CORPORATION

Salt Lake City, Utah—U.S.A. • Export Offices: Eimco Bldg., 52 South St., New York City

New York, N. Y. Chicago, Ill. San Francisco, Calif. El Paso, Texas Birmingham, Ala. Duluth, Minn. Kellogg, Ida. London, Eng. Paris, France Milan, Italy

80% more gypsum
on rubber than with tracks

Harris and Allen, Avenal, California, contracted to remove 75,000-yds. of gypsum from the McPhaill Co. pit at Avenal Gap. To handle 95% of the job, they brought in a rubber-tired Tournatractor with a LeTourneau 11-yd. LS Scraper . . . also a 148 hp crawler-tractor with a LeTourneau 18-yd. FP Scraper.

Both units self-loaded the powdery material . . . then hauled 400′ to 800′ to a stockpile. With project more than half completed, Tournatractor and pan had moved 70% of total yardage . . . crawler and pan, 25%.

187 vs. 104 loose yds. hourly

Even on minimum hauls of 400′, Tournatractor's 19 mph speed enabled it to outproduce the 5 mph crawler by 80%. Both tractors self-loaded in 175′ to 200′, according to contractor records. Tournatractor heaped 11 loose yds. in less than a minute . . . crawler was only able to get 13 loose yds. into its bigger scraper in the same time. Haul of 400′, dump, and return of 400′ took Tournatractor 2 minutes . . . crawler, 5 to 5½ minutes. In a 50-minute hour, Tournatractor made 17 trips, for an hourly output of 187 yds. . . . the crawler, with its longer haul time, averaged only 8 trips, for an hourly output of only 104 yds.

In addition to boosting production, Tournatractor paid off in lower maintenance. Because 4 big rubber tires replace about 500 wearing parts of a crawler track assembly, unit needed less lubrication.

If you want to increase production and lower costs, it will pay you to contact your LeTourneau-Westinghouse Distributor *before you buy another tractor.* See Tournatractor in action on *your* work.

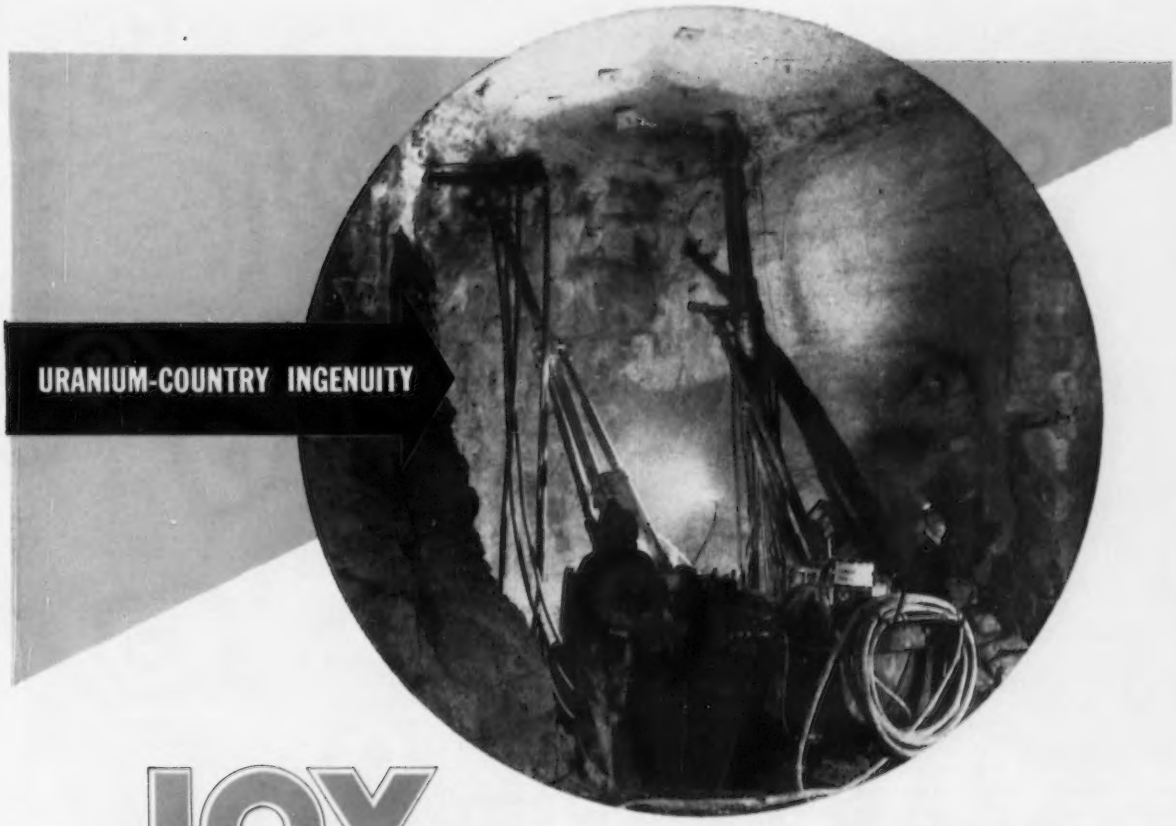
The recent purchase by Westinghouse Air Brake Company of the earthmoving and related business of R. G. LeTourneau, Inc., combines two firms which are world leaders in their respective fields. It brings together the earthmoving know-how of LeTourneau and the precision manufacturing and research experience of Westinghouse Air Brake. You can buy from this strong new company with even greater confidence than before.

Tournatractor—Trademark T-513-Q-b

LeTourneau-Westinghouse Company

PEORIA, ILLINOIS

A Subsidiary of Westinghouse Air Brake Company



..JOY DRILL JIB/TRACTOR COMBO

CUTS DRILLING COSTS 56¢ A TON!

A uranium mining company made their own Drillmobile by mounting two Joy LM-67 Drills with 6′ chain feeds and Hydro Drill Jibs on a diesel tractor. Result was an 80% reduction in labor costs!

This "Jib-Tractor" drills two faces a shift. Each face consists of 120 to 130 holes, is 18′ wide, 18′ to 20′ high. The Joy extendable Jibs drill horizontal holes up to the 18′ height and slanted holes at 20′.

Drilling speed in sandstone ranged from 30″ to 36″ per minute. Average footage drilled and broken is 7 feet. Ground broken per round is about 150 tons. Previously, air legs and stopers were used for drilling. The table at right illustrates the saving in drilling costs with this new "Jib-Tractor."

Write for Bulletin 87-F to ***Joy Manufacturing Company, Oliver Building, Pittsburgh 22, Pa.*** In Canada: *Joy Manufacturing Company (Canada) Limited, Galt, Ontario.*

FORMATION	Sandstone
DRIFT SECTION	18′ x 20′
HOLES PER FACE	120 to 130

	Jib-Tractor	Air Legs & Stopers
Rounds drilled per shift	2	½
Tons broken per shift	300	85
Labor cost per shift	$40	$60
Labor cost per ton	14c	70c
Saving per ton	56c	—

Consult a Joy Engineer

for AIR COMPRESSORS, ROCK DRILLS, HOISTS AND SLUSHERS

W&D M 5505

JOY

WORLD'S LARGEST MANUFACTURER OF UNDERGROUND MINING EQUIPMENT

FILLS TRUCK FAST with rich payloads from pockets that run 50 percent iron ore. Rugged INTERNATIONAL crawler with 41 drawbar horsepower loads out fast, moves to new locations quickly, makes recovery of ore from widely scattered pockets profitable for the large and small strip mines.

Strip Miner Cleans Up Rich Pockets

LOW-COST WAY TO STRIP OVERBURDEN FAST—with TD-9 powered Skid-Shovel that gets right down to payloads, moves heaped loads in high gear at ground level and keeps a big fleet of haul trucks rolling to make the operation profitable.

Fast-Moving INTERNATIONAL DROTT Skid-Shovel keeps 15 trucks busy, gets from pocket to pocket quickly

How to clear, strip and load out rich, but widely scattered, iron ore deposits profitably—that was the problem facing Alabama's Greenville Mining Company. President Eric Cumbie found the answer in an INTERNATIONAL DROTT TD-9 Skid-Shovel. This unit not only clears and strips but loads out so quickly it keeps a fleet of 15 haul trucks rolling. In addition, it moves from pocket to pocket fast, cleaning them out in a hurry.

That's why the head of this mining company reports:

"Using INTERNATIONAL *crawlers is a profitable experience. We find them powerful, productive and economical to maintain!"*

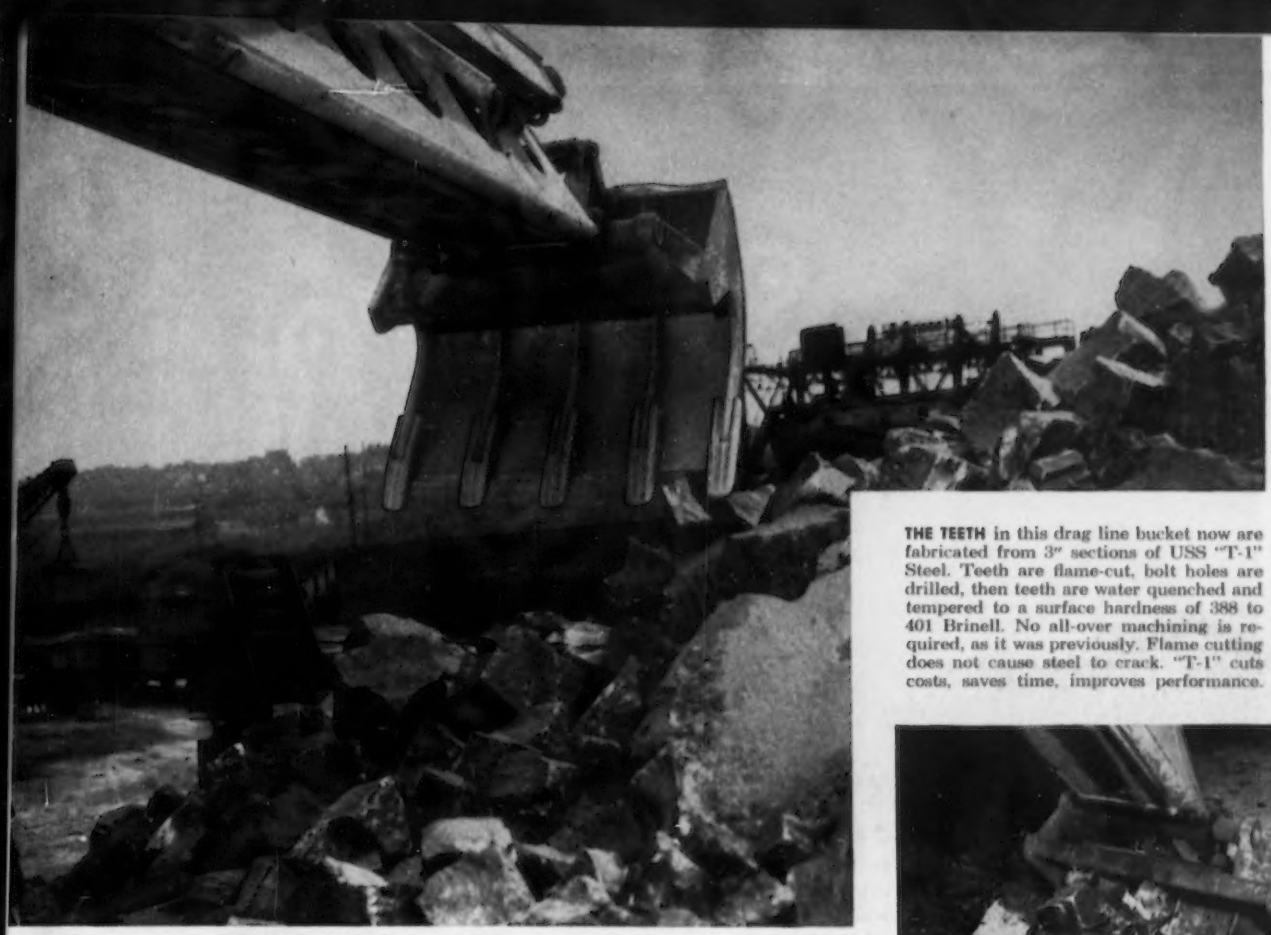
The TD-9 is but one of eight INTERNATIONAL diesel and carbureted crawlers that can power your mining operations more efficiently . . . with extra lugging power under overloads . . . with all-weather starting . . . with full-pressure lubrication systems . . . with efficient, closed system cooling . . . with accurately metered fuel injection for outstanding fuel economy . . . with unit construction that speeds servicing and maintenance.

Your nearby INTERNATIONAL Industrial Power Distributor will gladly demonstrate—you name the day!

INTERNATIONAL HARVESTER COMPANY, CHICAGO 1, ILLINOIS

INTERNATIONAL HARVESTER

INTERNATIONAL
INDUSTRIAL POWER
MAKES EVERY LOAD A PAYLOAD



THE TEETH in this drag line bucket now are fabricated from 3" sections of USS "T-1" Steel. Teeth are flame-cut, bolt holes are drilled, then teeth are water quenched and tempered to a surface hardness of 388 to 401 Brinell. No all-over machining is required, as it was previously. Flame cutting does not cause steel to crack. "T-1" cuts costs, saves time, improves performance.

How USS "T-1" Steel in Drag Line Bucket Teeth increased service life ten times

This hefty drag line is used to break and load ferromanganese which is made by the Blast Furnace Department of U.S. Steel's Duquesne Works. Ferromanganese is extremely hard and dense, so the bucket teeth must have exceptional resistance to impact abuse and abrasion.

When we bought this machine, the manufacturer used the best steel then available for the job. But still the teeth broke easily – and lasted for only 4 to 8 hours of operation. Replacement down time was frequent and expensive.

Just as an experiment, we tried our new "T-1" Steel in this rugged application. It worked beautifully. Instead of 8 hours, we are getting *80 hours* of service from each set of teeth – ten times more. Down time and replacement costs are about *a tenth* of what they used to be. Naturally we'll continue to use "T-1" Steel in this job, in the entire bucket as well as the teeth.

USS "T-1" Steel can cut costs for you in a wide variety of applications. Write for detailed facts and figures.

USE "T-1" AT HIGH TEMPERATURES. New USS "T-1" Steel has good creep rupture strength up to 900° F. It is being used in heavy-duty parts that operate at high temperatures.

USE "T-1" AT LOW TEMPERATURES. This same steel is amazingly tough at sub-zero temperatures. In pressure vessels, it has survived impacts of 2,000,000 ft. lbs. at 38 degrees below zero F. In addition, it has good resistance to impact abrasion.

USE "T-1" TO CUT FABRICATING COSTS. You have a yield strength of 90,000 psi. in "T-1" yet you can weld or flame cut this steel without pre- or post-heating. Your welds will develop the full 90,000 psi. And you can fabricate parts either in the shop or the field—wherever it is more convenient and less costly. With "T-1" Steel you can save money or improve design—sometimes both—in bridges, pressure vessels, heavy-duty trucks, excavating machines, mine cars, high speed rotating machines, steel mill equipment, and stamping and forging presses.

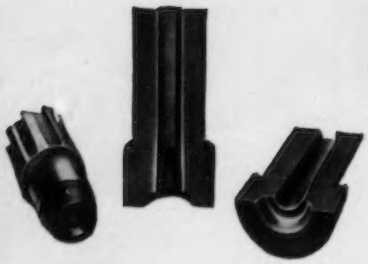
UNITED STATES STEEL CORPORATION, PITTSBURGH • COLUMBIA-GENEVA STEEL DIVISION, SAN FRANCISCO
TENNESSEE COAL & IRON DIVISION, FAIRFIELD, ALA. • UNITED STATES STEEL SUPPLY DIVISION, WAREHOUSE DISTRIBUTORS, COAST-TO-COAST
UNITED STATES STEEL EXPORT COMPANY, NEW YORK

USS "T-1" CONSTRUCTIONAL ALLOY STEEL

USS

5-201

UNITED STATES STEEL



This Set of Dies, for forming attachment ends, has remarkable toughness imparted by nickel. As a result, these dies can withstand heavy-duty service for long periods in the field.

Drill Steel Showing Shank formed by an I-R Drill Steel Sharpener. The attachment end, also forged by the machine, is shown after threading.

Nickel Alloyed Steel Dies contribute to both efficiency and economy of Drill Steel Sharpeners like this Ingersol-Rand Model 54 . . . a type which often serves in remote parts of the world, where repair and replacement parts are sometimes difficult or impossible to obtain.

How Ingersoll-Rand extends life of Drill Steel Sharpener dies

Operated by compressed air, I-R Drill Steel Sharpeners not only form shanks and attachment ends on Jackrods, but are also used to turn out a variety of other small forgings needed in the field.

Accordingly, you can appreciate why all dies, formers, dollies and the like . . . supplied for this work . . . must have ample stamina for repeated use on the job.

And for this repeated use, Ingersoll-Rand produces these vital parts in a die steel containing from 1½ to 2% nickel.

The addition of nickel imparts toughness, along with ample strength and hardness. This combination of properties in a die enables the user to turn out uniform, accurate, true-to-shape forgings rapidly. For example, on one of the larger units, it is possible to forge as many as 50 shanks an hour.

This is one more example of the way nickel, either alone or in combination with other alloying elements, makes possible controlled improvement of specific properties. For the best set of properties to improve your products or equipment, look to alloys containing nickel. Send us details of your metal problem for our suggestions. Write us today.

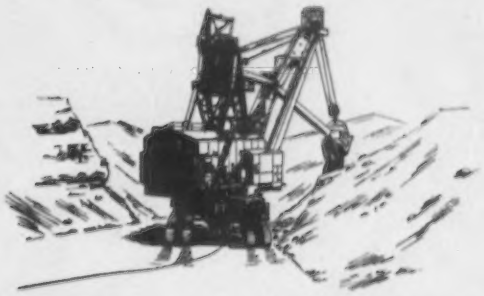
INCO
TRADE MARK

THE INTERNATIONAL NICKEL COMPANY, INC. 67 WALL STREET NEW YORK 5, N. Y.

Roebling Roeclad Type SH-D Trailing Cable is approved by the Pennsylvania Bureau of Mines Approval P-111, and complies with the requirements of the U. S. Bureau of Mines for flame-resistance. It is continuously mold marked for positive identification.

For safety... maximum service life...

ROECLAD TYPE SH-D TRAILING CABLE



BUILT FOR heavy duty service on such equipment as shovels, draglines and dredges. This cable is designed to provide maximum protection for workmen and longest life on the job under the most arduous conditions.

CONSTRUCTION

Conductors are tinned copper wire, rope stranded for extra flexibility.

Insulation over conductors is ozone and heat resistant, high voltage rubber compound.

Cabling – Multiple conductor cables are cabled together with rubber fillers (for greater flexibility, jute fillers may be specified).

Reinforcing braid is seine twine, for greater impact and tear resistance.

Jacket is made of thick Roebling Roeprene (neoprene), lead mold cured to give the cable firmness and compactness. The jacket is highly resistant to impact, abrasion, moisture, sun-cutting and deterioration from oil and chemicals.

If you want more information call your nearest Roebling office (listed below) or your Roebling distributor, or write to John A. Roebling's Sons Corporation, Trenton 2, N. J.

ROEBLING (CF)

Subsidiary of The Colorado Fuel and Iron Corporation

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WALSEAL® VALVES AND FITTINGS

Better because . . . **There's no guesswork when a silver-brazed joint is made with a Walseal fitting. Sil-Fos alloy, which appears as a fillet at the face of a Walseal joint, comes from rings which have been factory-inserted in the end connections of Walseal fittings. The bright silver alloy fillet that you can see assures full penetration of alloy for a permanently leakproof joint.**

Walseal is a registered trade mark identifying bronze valves and fittings manufactured by the Walworth Company. Walseal products have factory-inserted rings of silver brazing alloy in threadless ports. Walseal joints can be made only with Walseal valves and fittings.

If you're piping water, oil, steam, air, oxygen, nitrogen, helium or other industrial gases or refrigerants through brass, copper, or copper-nickel pipe, you'll want to investigate Walseal – available in complete lines of bronze valves and fittings in four distinct pressure ranges – from 0 to 5000 psi. working pressure*. Your copy of Circular 115 will be sent on request . . . see your near-by Walworth Distributor today, or write to: Walworth Company, General Offices, 60 East 42nd Street, New York 17, N. Y.

Cutaway view of a Walseal Tee showing: factory-inserted ring of silver brazing alloy; fillet of silver brazing alloy that appears upon completion of Walseal joint; cutaway view of the completed joint showing that silver brazing alloy has flowed in both directions from the factory-inserted ring.

Make it "a one-piece pipeline" with WALSEAL

SEE OUR CATALOG IN SWEET'S

WALWORTH

Manufacturers since 1842

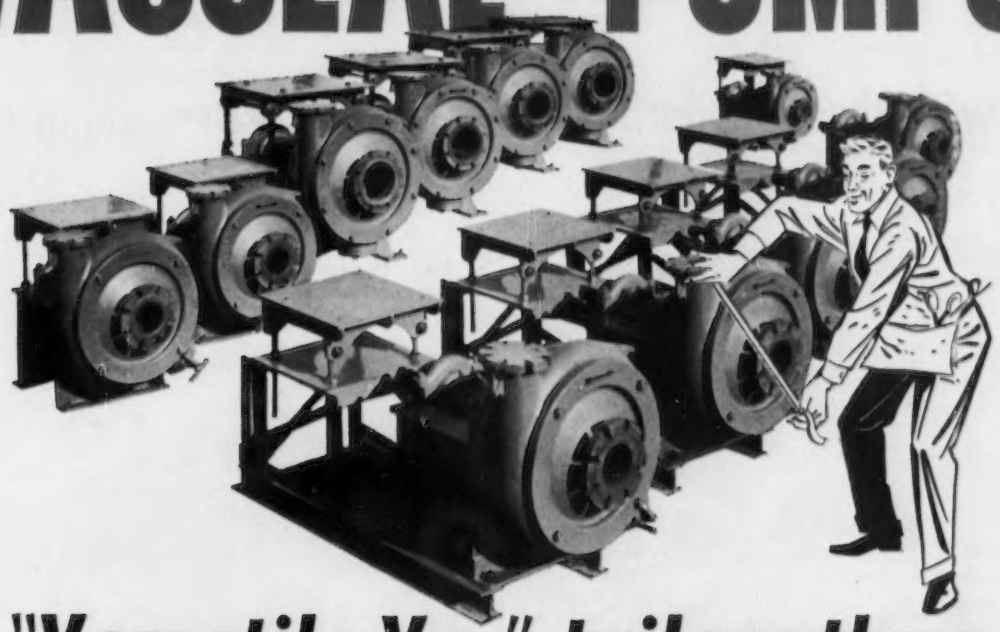
valves . . . pipe fittings . . . pipe wrenches

60 East 42nd Street, New York 17, N. Y.

DISTRIBUTORS IN PRINCIPAL CENTERS THROUGHOUT THE WORLD

*Walseal fittings and valves are being used at sub-zero temperatures as low as —350 F.

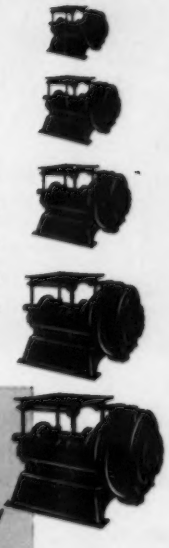
VACSEAL PUMPS



"Versatile Vac" tailors them to all industrial requirements

Size and Capacity for Heads from 0 to 150 feet:

2" - - - 50 to 190 g.p.m.
3" - - - 150 to 500 g.p.m.
4" - - - 300 to 700 g.p.m.
6" - - - 500 to 1500 g.p.m.
8" - - - 800 to 3600 g.p.m.



Other Galigher Products

Commercial and Laboratory AGITAIR
Acid-proof Sump Pumps
Laboratory Ball Mills
Geary-Jennings Sampler
Geary Reagent Feeder
Laboratory Pressure Filters

With all the efficiency you would expect of a pump specialized for materials handling, Vacseal pumps are 'tailored' for ALL kinds of pumping jobs in ALL industrial operations.

They can be rubber-lined, hard-iron or special alloy: acid proof or standard . . . providing a full range of handling abrasive or corrosive pulps. Motor mounts can be above or back of the pump or in practically any special position desired.

All Vacseal Pumps have the NO-SEALING-WATER feature that prevents dilution and damage so often due to failure of clear water supply.

Vacseal records of performance is a story you should certainly acquaint yourself with before choosing a pump for any use. May we send you our BULLETIN PB-52? No charge.

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THE GALIGHER CO.

METALLURGICAL DIVISION • ENGINEERING SERVICE •

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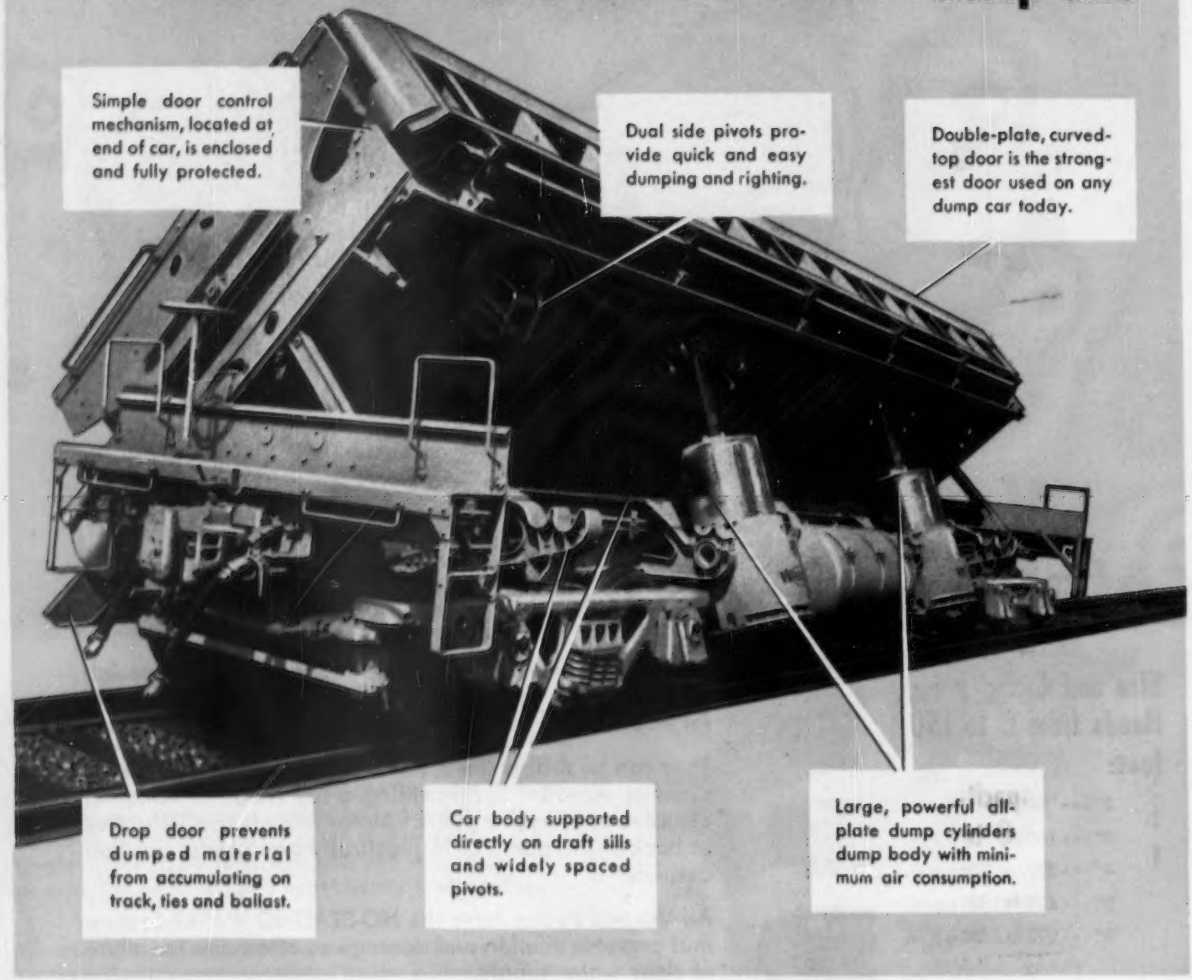
HOME OFFICE: Salt Lake City, Utah • P. O. Box 209
EASTERN OFFICE: 921 Bergen Avenue • Jersey City, New Jersey

You can save money

with these modern *Western* dump cars


Simple door control mechanism, located at end of car, is enclosed and fully protected.
Dual side pivots provide quick and easy dumping and righting.
Double-plate, curved-top door is the strongest door used on any dump car today.
Drop door prevents dumped material from accumulating on track, ties and ballast.
Car body supported directly on draft sills and widely spaced pivots.
Large, powerful all-plate dump cylinders dump body with minimum air consumption.

Modern Westerns have highly economical deadweight-to-payload ratio. Thanks to Westerns' design and the use of light but strong alloy steels, you get minimum haulage costs per ton-mile. And the rugged, maintenance-free construction of Westerns keeps operating and maintenance costs low and prolongs car-life.

Write now to Department 6608, Baldwin-Lima-Hamilton Corporation, Philadelphia 42, Pennsylvania, for further information about how you can cut your haulage costs with . . .

***Western* Cars . . . built by the world's largest manufacturer of dump cars**

BALDWIN - LIMA - HAMILTON

Philadelphia 42, Pa. • Offices in Principal Cities

Wire Rope at Work—At DeBardeleben Coal Corporation, Empire, Ala., tough stripping jobs like this one are part of the daily program. Thirty-seven feet of overburden is here being removed from the coal seam, and it is rough going, due in part to the large sandrock formations.

The dragline excavator is rigged with a 10½-yd bucket; the shovel with a 2-yd bucket. To help combat the very mean conditions, both machines use Bethlehem wire rope, Purple Strand grade, for hoist and boom lines. The big dragline, a 2⅛-in. rope, is also Purple Strand. In a service that is unusually severe, these Bethlehem ropes have shown the stubborn toughness and strength that are always the mark of top performers.

Bethlehem Steel Company, Bethlehem, Pa. On the Pacific Coast Bethlehem products are sold by Bethlehem Pacific Coast Stee Corporation. *Export Distributor:* Bethlehem Steel Export Corporation

Mill depots and distributors from coast to coast stock Bethlehem rope for the following industries and numerous others:

MINING • CONSTRUCTION • PETROLEUM • EXCAVATING • QUARRYING • LOGGING • MANUFACTURING

A DEEP HOLE SET-UP...

IN CLOSE QUARTERS

Here, combined in one compact machine, is a powerful rotary drill, with an entirely independent motor feed, that can be quickly set up in restricted areas. And that's not all! With the CP-555 Rotauger you can double your drilling speed in gypsum, talc, medium limestone and other relatively soft formations — two to six feet per minute in depths to one hundred feet. For more information, write for Bulletin SP-3110. *Chicago Pneumatic Tool Company, 8 East 44th St., New York 17, N. Y.*

Chicago Pneumatic

PNEUMATIC TOOLS • AIR AND GAS COMPRESSORS • ELECTRIC TOOLS • DIESEL ENGINES • ROCK DRILLS • HYDRAULIC TOOLS • VACUUM PUMPS

HD-5G removes mill tailings from a settled tailings pond. Material has been processed for vanadium and will now be processed for uranium. These tailings are wet, heavy and excessively abrasive.

Thousand-Hour Seals on Allis-Chalmers Tractors Increase Tonnage for Hundreds of Uranium Miners

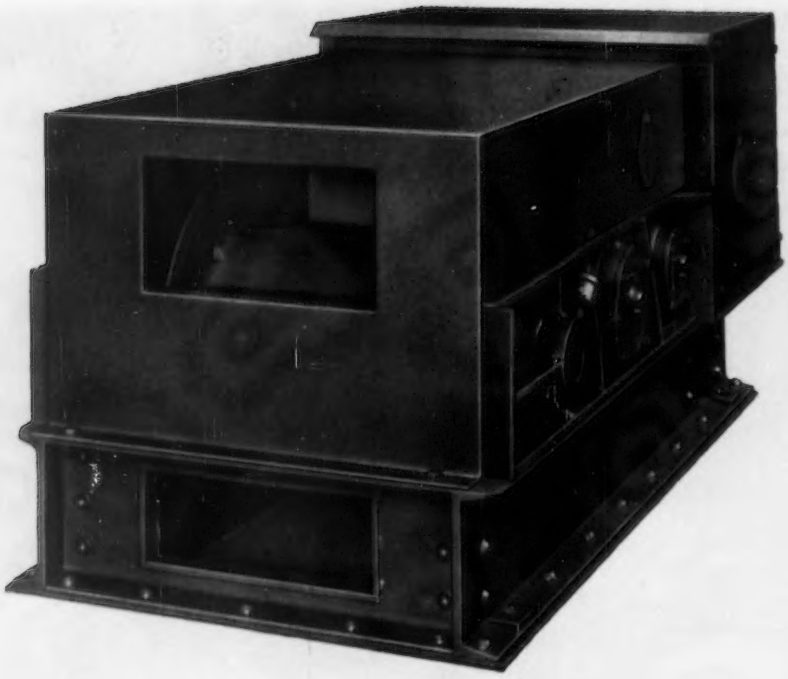
All day long, these tracks grind through a fog of fine, gritty dust as the HD-5G loads uranium ore at the mine. It takes extremely efficient seals to protect bearings in the track assembly under these conditions.

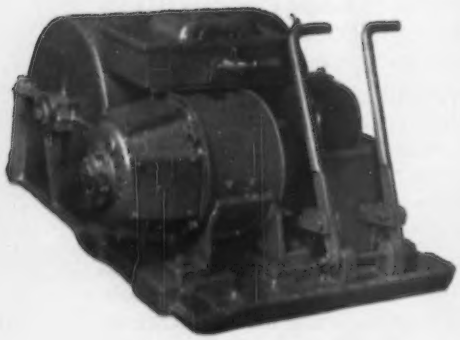
Sometimes it's wallowing in abrasive muck . . . sometimes in fine, penetrating dust. In either case, a tractor works all day in "grinding compound" when it handles uranium ore.

Ability to stand up under conditions like these accounts for the outstanding popularity of the Allis-Chalmers HD-5G Tractor Shovel. Truck wheel, idler and support rollers ride on tapered roller bearings with positive seals that keep dirt out . . . grease in. Seals are so efficient, in fact, that these bearings need lubricating only once every 1,000 hours — just twice a year based on a 40-hour week.

Users find that this feature alone adds up to many tons of extra production a month. Write for literature or ask your Allis-Chalmers dealer to show you how this servicing time saved means work time gained in any mine.

ALLIS-CHALMERS
TRACTOR DIVISION • MILWAUKEE 1, U. S. A.





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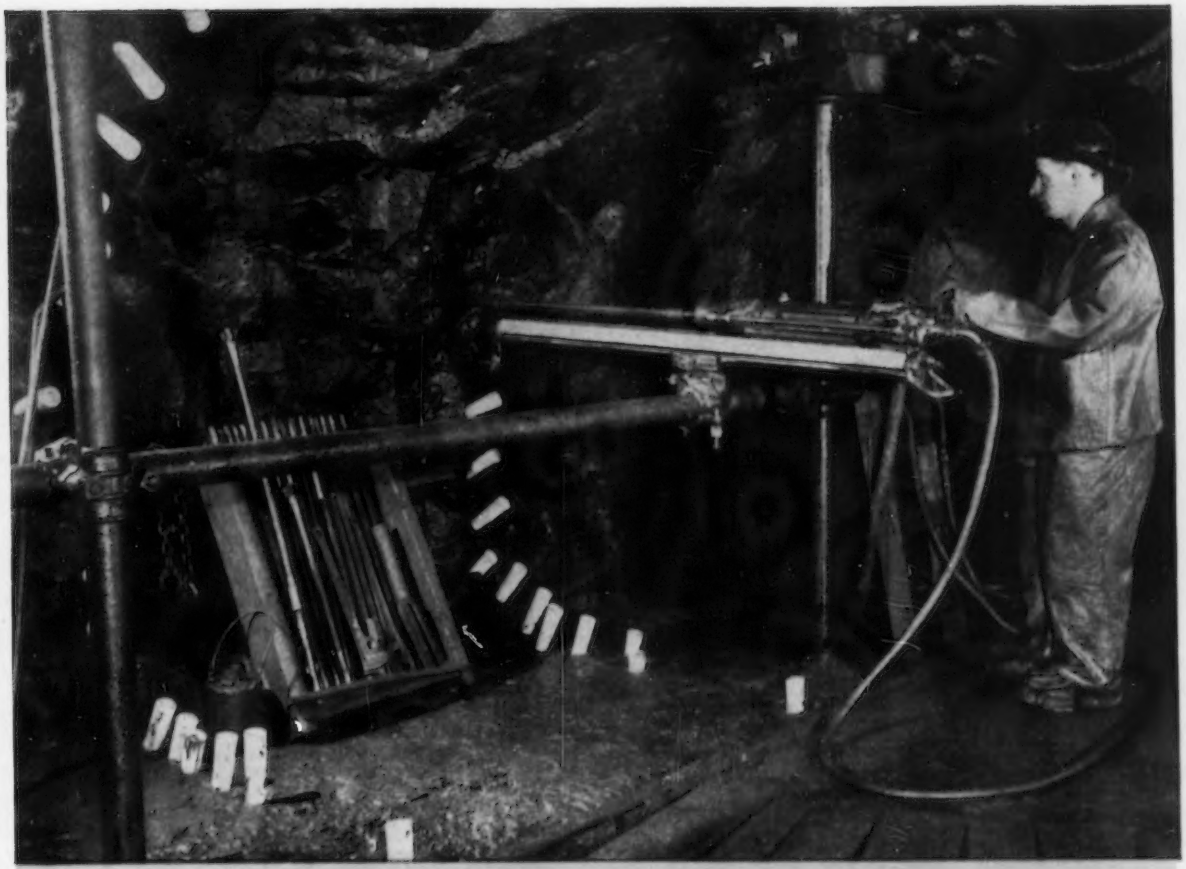

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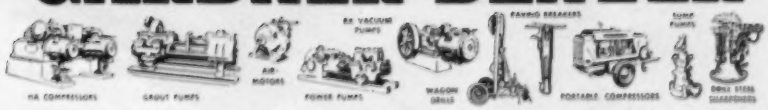

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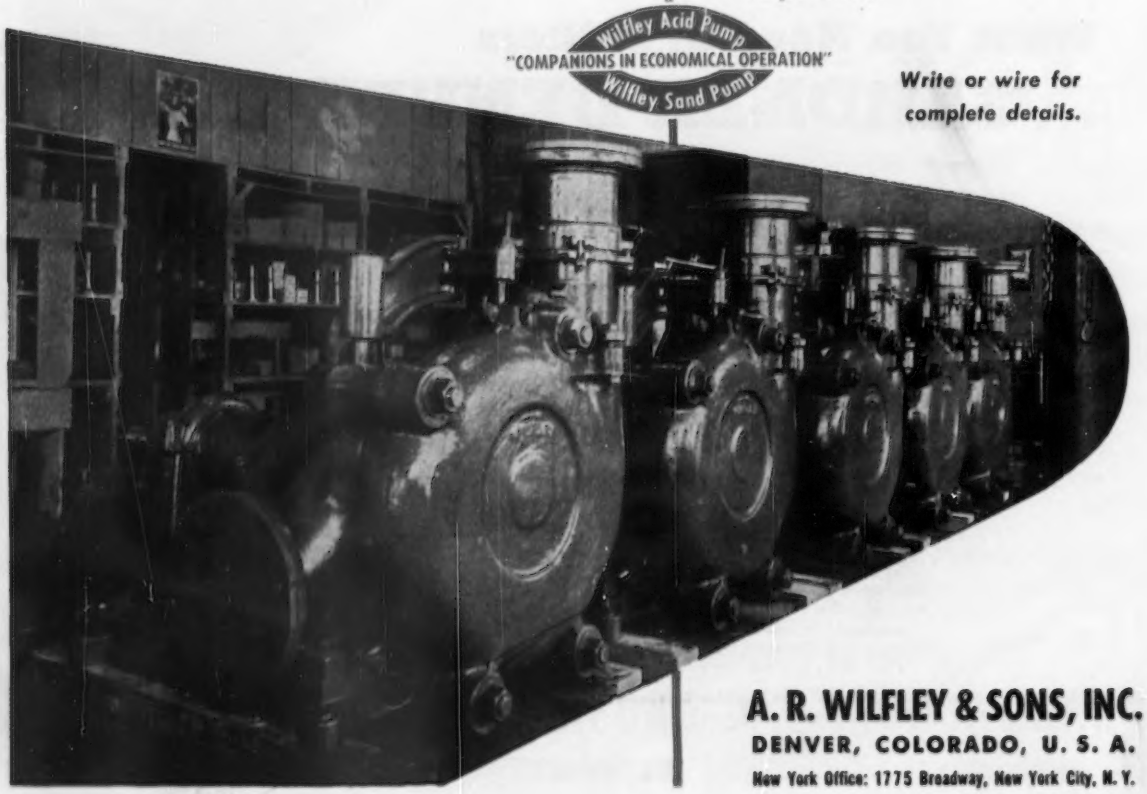

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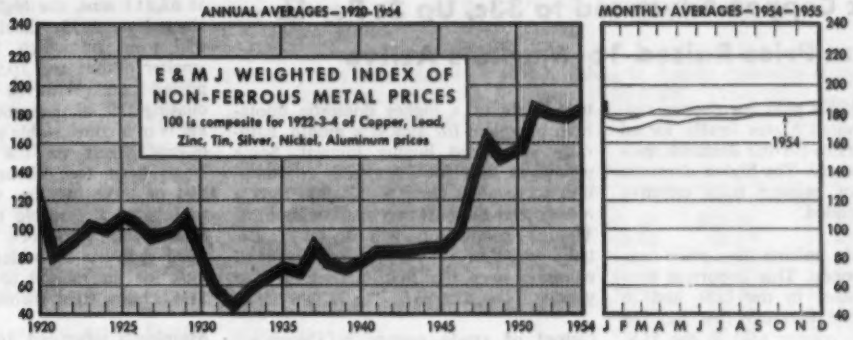
E&MJ OUTLOOK

PRICES



MARKETS

A 3c jump in the domestic copper price, announced late in January, plus a 1c rise in aluminum, edged the E&MJ index of non-ferrous metal prices up to 187.74 for January, against 187.45 for December. The index is certain to rise again in February, when the full impact of the rise in copper is felt.

Tin was again the unhappy sole source of market weakness, owing to continued uncertainty over the advent of production controls under the International Tin Agreement.

Copper producers at last gave up on trying to maintain a reasonable price rather than follow the day-to-day gyrations of foreign metal. Upward pressure on price grew irresistible because of: 1, the prolonged labor dispute in Rhodesia; 2, Chile's demand for more money for its distressed home economy; 3, the Formosan crisis.

We should know better, but we'll still hazard a guess that, if there's no more labor trouble in major copper mines, there'll be no further price increase (in domestic copper), and the supply situation will ease gradually over the next six months.

●

LABOR

True Confessions Note: If he can find a publisher, a former Mine, Mill party-liner wants to Tell All, putting the finger on the Communists among his old associates. He's had a pretty tough time lately, we hear.

●

AT HOME

Business is too good, it seems, in the first months of 1955. It has some observers wondering if we're riding for a fall. Autos are pouring out of Detroit at an 8.5 million annual rate, certainly impossible to maintain. Housing, road building, all the economic indicators, are up farther and faster than anyone had predicted.

Best guess, however, is still that, unless a shooting war develops out of the Formosan crisis, things will level off later this year without a serious inflation or a serious slump.

Present demand for metals, growing largely out of stepped-up automobile production, are likely to ease somewhat in the next few months. There is no present sign of a slump in demand, however.

Another Boom Note: We hear that the Denver office of the SEC is getting papers from around 60 hopeful new uranium mining companies a month.

●

ABROAD

Iron Curtain countries, desperate for copper, lead, and other metals, get it by buying semi- or fabricated products. Price is no object. That's the source of much of the sustained demand for metals.

MARKETS—Trends and Prices

Domestic Copper Advanced to 33c, Up 3c Per Lb—Aluminum Price Raised 1c—Markets Active

HIGHER PRICES paid for copper outside of the United States finally forced major producers to lift the domestic quotation 3c per pound. The higher domestic market did not become fully effective until January ended.

Initial action in raising the price was taken by Anaconda. This important producer, with mines in the U.S. and in Chile, announced that effective Jan. 28 it will price its copper sold in the U.S. market, regardless of origin, on the basis of 33c per pound, delivered, or 3c above the quotation that major producers established as far back as April 1, 1953. Custom smelters and smaller domestic producers also advanced on the same day to the 33c basis on Anaconda's move. Phelps Dodge advanced its quotation to the higher level beginning with Jan. 31; Kennecott held off until Feb. 1.

Most observers were confident that the supply situation in copper would improve after the turn of the year. However, several developments again upset the market and the ensuing scramble for metal forced prices upward all along the line. A strike of mine workers in the Rhodesian copper belt, instead of being a minor affair, was in its fourth week as January ended. (Rhodesia has been contributing around 32,000 tons a month to the world's supply.) Then the Chilean authorities pressured the Chilean producers for a higher price, threatening to divert larger tonnages to the European market. The Formosan crisis added to the complications and the London Metal Exchange staged another sharp upturn. European buyers were in the market for second and third quarter copper at steadily rising prices. From present indications the demand for copper outside of the U.S. promises to continue at a high rate. Most operators are convinced that fairly large tonnages of copper products in one form or another are moving to countries behind the Iron Curtain.

Sales of January shipment copper to domestic consumers exceeded 107,000 tons. Talk of a higher domestic quotation, prevalent for almost a month, naturally stimulated buying interest. Some producers now look for U.S. consumption to average close to 120,000 tons a month over the next two or three months. Though production will increase, the tight situation in copper is certain to continue over the first quarter of the year.

Output of crude copper in December in the U.S. totaled 97,806 tons, against 97,837 tons in November and 79,231 tons in October, according to Copper Institute. The monthly low in crude production for 1954 was 62,047 tons in August. U.S. deliveries of refined copper to fabricators in December totaled 119,626 tons, against 118,925 tons (revised) in the preceding month. The totals included copper delivered from Government stocks other than metal actually in the stockpile.

Lead consumers were in the market for substantial tonnages of the metal. A firmer foreign market renewed confidence in the stability of the 15c N.Y. quotation. The Far Eastern crisis also helped buyers make up their minds. There was no move to disturb the quotation which was quite firm as the month ended. Foreign demand was active. The f.a.s. Gulf quotation advanced from 13¼c to 13½c per pound. The General Services Administration was in the market for lead for the stockpile for delivery by March 15.

Zinc enjoyed a brisk market, with the demand for the die casting grade particularly active, reflecting a high rate of consumption in the automobile industry. Galvanizers also absorbed good tonnages. The industry was divided on the price outlook. Total available supply continues in excess of actual consumption, yet domestic output is being increased. Slab zinc consumption in the U.S. for November was estimated by the Bureau of Mines at 82,111 tons, the highest monthly rate since June 1953. Total supply was 91,035 tons, of which 80,119 was U.S. smelter output and 10,916 tons was imported metal. With the Government purchasing zinc of domestic origin, the market is in a comfortable position. Zinc was offered freely on the 11½c East St. Louis basis for delivery over the next two or three months, which put a stop to talk of a possible rise at this time. Sellers willing to book business for forward delivery at a flat price evidently look for the market to continue on the 11½c basis right through June.

Aluminum advanced 1c per pound, beginning with Jan. 10 when Reynolds Metals announced the price change to take care of higher costs. Kaiser followed on Jan. 12 and Alcoa on Jan. 13. Demand has been even better than anticipated, with the improvement in business world-wide, just as in copper. Production of primary aluminum in the U.S. in December was 127,056 tons.

Tin was unsettled pending further developments in connection with the control scheme. Production continues in excess

Average Prices for January (E&MJ Quotations)

Copper:	
Electrolytic, domestic, refinery	29.783
Electrolytic, export, refinery	32.574
Lead:	
Common, New York	15.000
Common, St. Louis	14.800
Silver and sterling exchange:	
Silver, New York, per oz.	85.250
Silver, London, pence per oz.	74.238
Sterling Exchange, "Checks"	278.510
Zinc:	
Prime Western, East St. Louis	11,500
Prime Western, delivered (g)	12.000
Tin:	
New York Straits	87.290
New York, 99% min. (e)	86.290
Gold, per oz. U.S. price	$ 35.000
Quicksilver, per flask	$322.000
Antimony (E&MJ) (d)	31.970
Antimony, bulk, Laredo	28.500
Antimony, in cases, Laredo	29.000
Platinum refined, per oz.	$79.500
Cadmium (a)	170.000
Cadmium (b)	170.000
Cadmium (c)	170.000
Aluminum, 99% plus ingot	22.880
Magnesium, ingot	27.000
Nickel (f)	64.500

Domestic quotations, unless otherwise stated, are in cents per pound. Sterling exchange checks, in cents. Quicksilver, per flask of 76 lb.

(a) Cadmium average based on the producers' quotations.

(b) Cadmium average based on the average of the producers' and platers' quotation.

(c) Cadmium average based on platers' quotation.

(d) Domestic, 5 tons or more but less than carload lots, packed in case f.o.b. New York.

(e) Tin content.

(f) F.o.b. Port Colborne, U.S. duty included.

(g) Delivered where freight exceeds 0.5c.

E & M J Index of Non-Ferrous Metal Prices

(100 is composite for 1922–3–4)

Year		1951	1952	1953	1954
1943	88.74	January	192.48	193.83	172.82	179.75
1944	88.74	February	194.06	195.10	172.29	178.17
1945	90.86	March	190.19	195.10	184.44	179.58
1946	110.06	April	190.18	194.93	182.61	183.27
1947	149.46	May	189.47	186.88	181.58	183.26
1948	168.38	June	187.19	179.18	182.63	184.61
1949	151.97	July	186.46	179.79	182.20	184.68
1950	156.42	August	186.15	178.70	182.70	184.65
1951	190.16	September	186.15	178.59	181.10	186.56
1952	183.33	October	193.21	173.85	180.05	187.50
1953	180.29	November	193.17	172.04	180.45	187.44
1954	183.91	December	193.17	172.00	180.66	187.45

Markets Continued on Page 139

of requirements. Prices steadied toward the end of January as tension over Formosa mounted.

Quicksilver in the wholesale market remained firm on light offerings from Spain. Delay in obtaining metal from Mexico due to licensing embarrassed some traders.

Manganese ore was in better demand, following the upturn in steel production. Prices paid were higher. Rising freight rates exerted a strengthening influence on the c.i.f. quotations.

Tungsten ore was up on steady buying by European consumers who were nervous over developments in the Far East. Business here improved too.

"Free" Gold Market

Gold markets were fairly active during January. Total valume rose about 6%. Far Eastern prices were higher as gold hoarding in Asiatic countries stimulated buying interest. Coin prices were up between 1% and 2%. There were no Russian sales. Pick's World Currency Report quotes on "free" gold, per fine oz. as follows:

	COINS		BARS (12.5 kg)	
	Dec. 30	Jan. 31	Dec. 30	Jan. 31
NEW YORK, transit	.....	.....	$35.10	$35.10
MANILA	$40.50	$40.50	37.80	37.65
HONG KONG	40.00	40.10	37.85	38.30
BOMBAY	49.00	53.75	48.65	53.50
TANGIER	38.75	39.25	35.00	35.05
BEYROUTH	39.90	39.90	35.18	35.20
PARIS	38.40	39.50	35.50	35.75
BUENOS AIRES	40.95	42.60	39.50	38.75

Note: All prices are computed at the free or black market value of the U.S. dollar in the local markets.

Major Metals

U. S. DAILY AND AVERAGE PRICES

Jan. 1955	Electrolytic Copper (a) Domestic	Electrolytic Copper (b) Export	Straits Tin New York	Lead New York	Lead St. Louis	Zinc Delivered (f)	Zinc East St. Louis
1	Holiday	Holiday	Holiday	Holiday	Holiday	Holiday	Holiday
3	29.700	30.525	88.125	15.000	14.800	12.000	11.500
4	29.700	31.325	87.125	15.000	14.800	12.000	11.500
5	29.700	31.225	86.500	15.000	14.800	12.000	11.500
6	29.700	31.275	85.750	15.000	14.800	12.000	11.500
7	29.700	32.250	86.250	15.000	14.800	12.000	11.500
8	No Market	31.525	86.250	15.000	14.800	12.000	11.500
10	29.700	31.875	85.875	15.000	14.800	12.000	11.500
11	29.700	31.500	86.125	15.000	14.800	12.000	11.500
12	29.700	30.975	87.125	15.000	14.800	12.000	11.500
13	29.700	32.600	86.500	15.000	14.800	12.000	11.500
14	29.700	32.300	86.500	15.000	14.800	12.000	11.500
15	No Market	32.300	86.500	15.000	14.800	12.000	11.500
17	29.700	32.925	86.750	15.000	14.800	12.000	11.500
18	29.700	32.550	86.750	15.000	14.800	12.000	11.500
19	29.700	31.775	86.250	15.000	14.800	12.000	11.500
20	29.700	33.425	87.000	15.000	14.800	12.000	11.500
21	29.700	34.225	86.875	15.000	14.800	12.000	11.500
22	No Market	32.775	86.875	15.000	14.800	12.000	11.500
24	29.700	33.225	88.000	15.000	14.800	12.000	11.500
25	29.700	33.175	88.500	15.000	14.800	12.000	11.500
26	29.700	32.850	88.875	15.000	14.800	12.000	11.500
27	29.700	32.200	88.500	15.000	14.800	12.000	11.500
28	30.325	34.725	89.500	15.000	14.800	12.000	11.500
29	No Market	34.700	89.500	15.000	14.800	12.000	11.500
31	30.825	36.125	90.250	15.000	14.800	12.000	11.500
AVERAGES FOR MONTH							
Jan.	29.783	32.574	87.290	15.000	14.800	12.000	11.500
AVERAGES FOR WEEK							
Jan.							
5	29.700	31.295	87.500	15.000	14.800	12.000	11.500
12	29.700	31.567	86.229	15.000	14.800	12.000	11.500
19	29.700	32.408	86.542	15.000	14.800	12.000	11.500
26	29.700	33.279	87.688	15.000	14.800	12.000	11.500
CALENDAR WEEK AVERAGES							
Jan.							
1	29.700	31.265	87.525	15.000	14.800	12.000	11.500
8	29.700	31.354	86.667	15.000	14.800	12.000	11.500
15	29.700	31.925	86.438	15.000	14.800	12.000	11.500
22	29.700	32.946	86.750	15.000	14.800	12.000	11.500
29	29.825	33.479	88.813	15.000	14.800	12.000	11.500

Silver, Gold and Sterling

DAILY AND AVERAGE PRICES

Jan. 1955	Sterling Exchange "Checks"	Silver (c) New York	Silver (c) London	Gold London	Gold (a) United States
1	Holiday	Holiday	Holiday	Holiday	Holiday
3	278.5312	85.250	74.250d.	251s. 6¼d.	$35.00
4	278.5429	85.250	74.250d.	251s. 6d.	35.00
5	278.6250	85.250	74.250d.	251s. 6¼d.	35.00
6	278.5937	85.250	74.250d.	251s. 5¾d.	35.00
7	278.6718	85.250	74.250d.	251s. 5d.	35.00
8	(e)	(e)	(e)	(e)	35.00
10	278.6562	85.250	74.250d.	251s. 6d.	35.00
11	278.6875	85.250	74.250d.	251s. 5¼d.	35.00
12	278.6250	85.250	74.250d.	251s. 5¾d.	35.00
13	278.5312	85.250	74.250d.	251s. 6¼d.	35.00
14	278.5312	85.250	74.250d.	251s. 7d.	35.00
15	(e)	(e)	(e)	(e)	35.00
17	278.4687	85.250	74.250d.	251s. 7d.	35.00
18	278.3750	85.250	74.250d.	251s. 8d.	35.00
19	278.3750	85.250	74.250d.	251s. 9¼d.	35.00
20	278.3750	85.250	74.250d.	251s. 8d.	35.00
21	278.5000	85.250	74.250d.	251s. 7¼d.	35.00
22	(e)	(e)	(e)	(e)	35.00
24	278.3750	85.250	74.250d.	251s. 8d.	35.00
25	278.4375	85.250	74.250d.	251s. 9d.	35.00
26	278.4375	85.250	74.250d.	251s. 9d.	35.00
27	278.4687	85.250	74.250d.	251s. 8¼d.	35.00
28	278.4687	85.250	74.250d.	251s. 7½d.	35.00
29	(e)	(e)	(e)	(e)	35.00
31	278.4375	85.250	74.000d.	251s. 7¼d.	35.00
AVERAGES FOR MONTH					
Jan.	278.510	85.250	74.238	—	35.00
AVERAGES FOR WEEK					
Jan.					
5	278.552	85.250	—	—	—
12	278.647	85.250	—	—	—
19	278.456	85.250	—	—	—
26	278.425	85.250	—	—	—

Calendar Week Averages: New York Silver: Jan. 1st, 85.250; 8th, 85.250; 15th, 85.250; 22nd, 85.250; 29th, 85.250.
(e) No Market (Saturday).

THE above quotations for major non-ferrous metals are our appraisal of the important United States markets, based on sales reported by producers and agencies. They are reduced to the basis of cash, New York or St. Louis. All prices, except gold and silver, are in cents per pound.

(a) Net prices at refineries on Atlantic seaboard. To arrive at the delivered New England basis add 0.300c per pound, the average differential for delivery charges.

(b) Our export quotations for copper reflects prices obtaining in the open market and is based on sales in the foreign market reduced to the f.o.b. refinery equivalent, Atlantic seaboard. On f.a.s. transactions we deduct 0.075c for lighterage, etc., to arrive at the f.o.b. refinery quotation.

Copper, lead and zinc quotations are based on sales for both prompt and future deliveries; tin quotations are for prompt delivery only.

Quotations for copper are for the ordinary forms of wirebars and ingotbars; cathodes are sold at a discount of 0.125c to 0.15c per pound. Quotations for zinc are based on Prime Western brands. Zinc in New York commands a premium over the St. Louis basis equal to the freight differential. Contract prices for High Grade zinc delivered in the East, Middle West, and West, effective Jan. 1, 1951, commanded a premium of 1.35c per pound over the current market for Prime Western; Special High Grade 1.50c.

(f) Prime Western delivered where freight from E. St. Louis exceeds one-half cent.

Quotations for lead are based on domestic common lead. Corroding lead commands a premium of 10 points.

(c) The daily New York silver quotation reported by Handy & Harman is for silver contained in ores and other unrefined silver-bearing materials, in cents and fractions of a cent per troy ounce. It is determined by Handy & Harman on the basis of actual sales of bar silver .999 fine in amounts of 50,000 ounces or more for nearby delivery at New York, as reported daily by regular suppliers, and is usually one quarter-cent below the price paid for such bar silver, this deduction being the allowance to such suppliers for carrying, delivering and marketing. In addition to foreign silver, the quotations also apply to domestic silver if such silver enters into the New York market.

The Treasury's purchase price of newly mined domestic silver is 90.5 per troy ounce 1000 fine, effective July 1, 1946. London silver is pence per troy ounce, basis .999 fine.

(d) U.S. Treasury's gold price. Actual payment by the United States Treasury for gold is at 99.75 per cent of the price quoted by the Treasury, which is equal to $34.9125.

Behind the By-Lines...

G. P. Lutjen

Men of distinction, 39 of them, and one lady of distinction, all pictured on pages 72 to 74, deserve the credit for *E&MJ*'s 86th Annual Survey and Outlook. We were overruled, but still think we should have photographed each and every one replete with eye patch and Hathaway shirt, seated with distinction in a king-size wing chair, waving a distinctive glassful of ice cubes and Calvert's.

We are grateful to them all for a splendid job that should make this issue one of your more useful reference pieces. This year's edition, by the way, is larger by four commodities than any of its 85 predecessors, and membership in the *E&MJ* Review Writers' Benevolent Association is hereby extended to William Steele (Vermiculite), John Sargent (Selenium), John Crawford (Thorium), and Frank Lamb (Rare Earths).

We'd also like to welcome eight other newcomers to the roster with the hope that their by-lines will become February fixtures. By actual count, the tenure in office of the 28 veterans in this issue ranges from 2 to 16 years. Most especially are we proud of what would be the Ten-Year Club if we had one: Helena Meyer, Norwood Melcher, Hubert Davis, Charles Ince, and Hans Wanders. In addition to these five, there are nine more men who have had this review chore well in hand for periods of 5 to 10 years. For the whole crew, we hope that this annual contribution has been as satisfying to them as it has been useful to the readers.

E&MJ readers know pretty well what to expect of a review issue, but we have one or two startling surprises for you this year. Take the Mining Review for instance. We dare you to read it and not get trapped into some serious speculation on new approaches to solving some of mining's problems. For what you find on p 123 is not so much a review of practice, as a tour of the outposts of mining technology and some of the provocative situations now developing. We earnestly hope that you will do more than just read the review.

To illustrate: With the spreading use of radio communication in open pit mining, it is possible under certain circumstances, that currents can be set up in radio transmission that will cause premature detonation of explosives. The review suggests a simple method for checking your own installation for such a hazard. But let's go a step further; if you do check your own pit, or have already checked it, why not let us know the result. A compilation of this data (or these data) for a number of mines would provide an accurate picture of the potential danger, if any, and if there is any, what the critical conditions are.

Have you run an analysis of your tailings pond lately? You might have uranium and not even know it because the USGS has just published a list of mineralogic fugitives that could easily slip by your xanthates and aerofloats—and probably you're better off for it. Try these on your flowsheet: ampangabeite, mendeleyevite, calciosamarskite, cuprosklodowskite (not to be confused with jachymovite, according to Mineralogical Abstracts, Vol. 6, p345, 1936), epiianthinite (never trust a mineral whose "i"s are so close together), eschynite, yttrogummite (really only a synonym for gummite), bragite (alias fergusonite) and vandendreisscheite (however, the validity of this hydrous lead uranium oxide species—lean over a little closer—is reported to be highly questionable. It seems that in the ancestry of this progeny there was some question . . . well, maybe better not go into that now). There is also genuine zippeite ($2UO_3$ 5-$6H_2O$) to complete the alphabet.

These are only a few of the 238 minerals bearing uranium and thorium according to USGS Circular 74. Our vote for the most phonetic mineral goes to yamaguchilite. The one we'd least like to get tangled up with—polymignyte.

As if the uranium mining business isn't complicated enough, the AEC has announced mid-February atomic tests in Nevada. These tests, they say, are likely to result in "background radiation readings that are misleading in uranium prospecting activity." The duration of the tests depends on weather and other factors but, in the past, they have run as long as three months. The increased radiation is not expected to be hazardous to humans or livestock but may be awfully hard on the prospectors optimistic outlook. And if you are shopping for a uranium property—well, as the Romans put it so succinctly. "Caveat emptor." Especially if you're an emptor of uranium claims.

A belated Christmas story we heard last week illustrates pretty well the condition of affairs in New York. It seems that a VIP in one of the larger mining companies keeps his car in a garage that picks it up each night and delivers it to his door each morning. A week or two before Christmas he found on the front seat, an exceedingly attractive Yule greeting. It read, "Merry Christmas from the boys at the garage."

Filled with warm glow, he made a mental note as he drove to the office, to make his yuletide check a few dollars bigger this year. With one thing and another, however, he didn't get around to sending the check off. On the following week he found another card, "Merry Christmas from the boys at the garage; Second Notice."

The E&MJ Institute for Better Living It Up has been out of exotic recipes for some months now, but to prevent total loss, we are forwarding an idea from a martini fancying reader that we have had our research department experiment with and can now recommend for martini fanciers everywhere. The next time you stir up a batch, try using a little dry sauterne instead of vermouth. As someone's TV commercial puts it, "Man! It's a martinier tini!"

You'd be surprised at how you can startle people by suddenly confronting them with little known facts like—"Did you know that the total amount of aluminum produced in 1954 was less than the *entire* production for the three previous years?"

ENGINEERING AND MINING JOURNAL

FEBRUARY 1955

For 1955: Excitement, Expansion and Great Expectations

WHATEVER ELSE THE YEAR 1955 may turn out to be, it seems a safe bet that it won't be a dull one for mining men. In fact, this year is shaping up as one of the most interesting we have faced in a long time. Here are some of the reasons why:

1. **Uranium mining** should keep things humming this year as last, even though some of the speculative fever will, we hope, die away. Both in exploration and in metallurgy, the uranium field should provide some lively developments this year.

2. **New projects** are always exciting, and few in recent years have sparked the interest stirred by the ASandR-Newmont-Phelps Dodge-Cerro combination on the Toquepala-Cuajone copper project in Peru (See news pages). It will at least get a good start this year, and it provides an excellent example of what the right kind of industry-government relations can do both here and abroad.

3. **New processes** turn up on all sides. The one most likely to reach full fruition in 1955 is the Chemico process for producing pure metal powders. It's working through its first commercial stages for Sherritt-Gordon in Canada, producing nickel and cobalt, and it is still under final development for Howe Sound, National Lead, and Freeport Sulphur. A new leach-roasting technique for manganese is working on the Cuyuna Range, and is reported as promising.

4. **New plants** will appear in every phase of our industry. We intend to keep our eye on the three different plants for pelletizing taconite concentrates now under construction at Erie, Reserve, and Cleveland-Cliffs as being currently the most interesting new plants.

5. **New methods** for handling mining, milling, and smelting equipment, will be appearing this year. The simplified dragline controls we described in our April issue are just a foretaste of what's coming. Drilling, blasting, mucking, haulage, everything right through metal casting, are all under study right now by one company or another.

6. **New approaches** to all mining's technical problems are in the wind. "Operations research" is a phrase you'll be hearing more frequently this year than last. It simply means a scientific approach to getting the job done easier and quicker, and it has worked wonders in the manufacturing field. One company is even now applying it to exploration.

7. **New uses** for metals may develop before long as the result of research that will be started this year, for example, by the Zinc Institute. Also, credit the Copper and Brass Research Association with a nice job of publicizing the facts on the future availability of copper.

8. **New headaches** are also bound to develop in 1955. One of the biggest is tariff vs stockpiling question. It seems likely to have been won by stockpiling, but therein lies an even bigger headache—how do you quit stockpiling when you've made it an industry prop? And what do you do with a stockpile that's grown out of all reason?

All these things, and a great many more, certainly liven the prospect for 1955, to say the least. Added to this is the fact that for once most economists are united in forecasting a good year for business generally.

It all seems to add up to a good year for mining, too. It should be a year in which there'll be plenty of new developments to keep life interesting, and plenty of work to keep us occupied. We're looking forward to it.

These People Wrote

THE BETTER TO GIVE YOU AN IDEA of the volume and caliber of talent that has produced *Engineering and Mining Journal's* 86th Annual Survey and Outlook Number, we have departed from the practice of placing each author's picture with his review, and have assembled them on these three pages.

Some are old friends to *E&MJ* readers, having contributed consistently fine reviews for more than a dozen years. Others we welcome for the first time with a sin-

M. A. Kriz
Chief, Foreign Research Div.
Federal Reserve Bank of New York
Gold p 75

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Mgr. Sales & Tech. Svce.
Titanium Metals Corporation of America
Titanium p 79

Francis H. Wemple
Treasurer
Handy and Harman
Silver p 80

Irving Lipkowitz
Assistant to the President
Reynolds Metals Co.
Aluminum p 82

J. D. Hanawalt
Vice President and Manager
Magnesium Division
Dow Chemical Co.
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Hans H. Wanders
Market Editor
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Charles R. Ince
Vice President & Sales Manager
St. Joseph Lead Co.
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Secretary
Lead Industries Association
Lead p 90

Robert D. Nininger
Acting Assistant Director
Raw Materials Division
U. S. Atomic Energy Comm.
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Associate Market Editor
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Assistant Chief, Base Metals Branch
U.S. Bureau of Mines
Mercury p 95

Norwood B. Melcher
Chief, Ferrous Metals and Alloys Branch
U.S. Bureau of Mines
Ferroalloys p 96

Hubert W. Davis
Commodity Specialist
U.S. Bureau of Mines
Cobalt p 96
Nickel p 100

E&MJ's 86th Annual Review

cere wish for their continued association with the distinguished group of authors they join. We are especially pleased to introduce the authors of reviews of four commodities—vermiculite, thorium, selenium and rare earths—which are appearing in *E&MJ* for the first time as individual reviews.

To all these people, *E&MJ* wishes to express its warmest thanks for their cooperation, diligence and for the high quality of their work.

John D. Sargent
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U.S. Bureau of Mines
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Commodity-Industry
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U.S. Bureau of Mines
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Chief, Minerals Div.
U.S. Bureau of Mines
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Pickands, Mather & Co.
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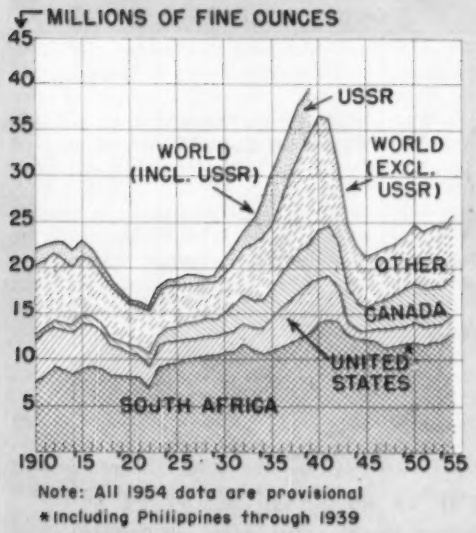
A. W. Schlechten
Chairman, Department of Metallurgical Engineering
Missouri School of Mines
Extractive Metallurgy p 134

World Gold Production



In millions of fine oz.	1940	1945	1951	1952	1953	1954*
North America:						
Canada	5.3	2.7	4.4	4.5	4.1	4.3
United States	4.9	0.9	1.9	1.9	2.0	1.9
Latin America:						
Mexico	0.9	0.5	0.4	0.5	0.5	0.5
Colombia	0.6	0.5	0.4	0.4	0.4	0.4
Chile	0.3	0.2	0.2	0.2	0.1	0.1
Nicaragua	0.2	0.2	0.3	0.3	0.3	0.2
Africa:						
Union of South Africa	14.0	12.2	11.5	11.8	11.9	13.2
Gold Coast	0.9	0.5	0.7	0.7	0.7	0.8
Southern Rhodesia	0.8	0 6	0.5	0.5	0.5	0.5
Belgian Congo	0.6	0.3	0.4	0.4	0.4	0.4
Asia:						
India	0.3	0.2	0.2	0.2	0.2	0.2
Philippines	1.1	...	0.4	0.4	0.5	0.5
Australia	1.6	0.7	0.9	1.0	1.1	1.1
Total	31.6	19.5	22.1	22.8	22.6	24.1
Other countries, excluding USSR	5.1	1.6	1.9	1.9	1.9	1.9
World, excluding USSR	36.7	21.1	24.0	24.7	24.5	26.0

*, Tentative figures based on preliminary data.
Note: Figures may not add up to totals because of rounding.

GOLD

Dr. M. A. Kriz[1]
New York, New York

THE YEAR 1954 was characterized by a marked advance toward a more satisfactory world gold situation. World gold output increased noticeably, for the first time since 1950. The rise was largely confined to South Africa, but certain other producing areas also showed gains. The rise in mining costs in 1954 was distinctly less than in any other year since 1945.

Newly-mined gold flowed into official monetary reserves in much larger amounts than at any time during the last ten years.

Movement of gold into private hoards largely subsided, and the price for gold bullion on markets abroad where gold is traded directly for U.S. dollars or other convertible currency remained near the official price.

The London gold market was reopened, on a restricted basis, after a closure of almost fifteen years. The monetary gold reserves of countries other than the U.S. increased substantially, along with their dollar assets, thus creating one of the essential prerequisites for the re-establishment of freer international payments.

Rise in World Output

World production of gold (excluding the USSR) amounted last year to some 26.0-million fine oz, or 1.5-million oz more than in 1953 (see table), on the basis of preliminary or incomplete data available at the year-end. Last year's production was 4.9-million oz above the 1945 postwar low, and some 10.7-million oz below the 1940 all-time record. However, current gold output is well above the 1920-1930 average, as may be seen from Fig. I, and is about equal to the average annual output of 1935 and 1936.

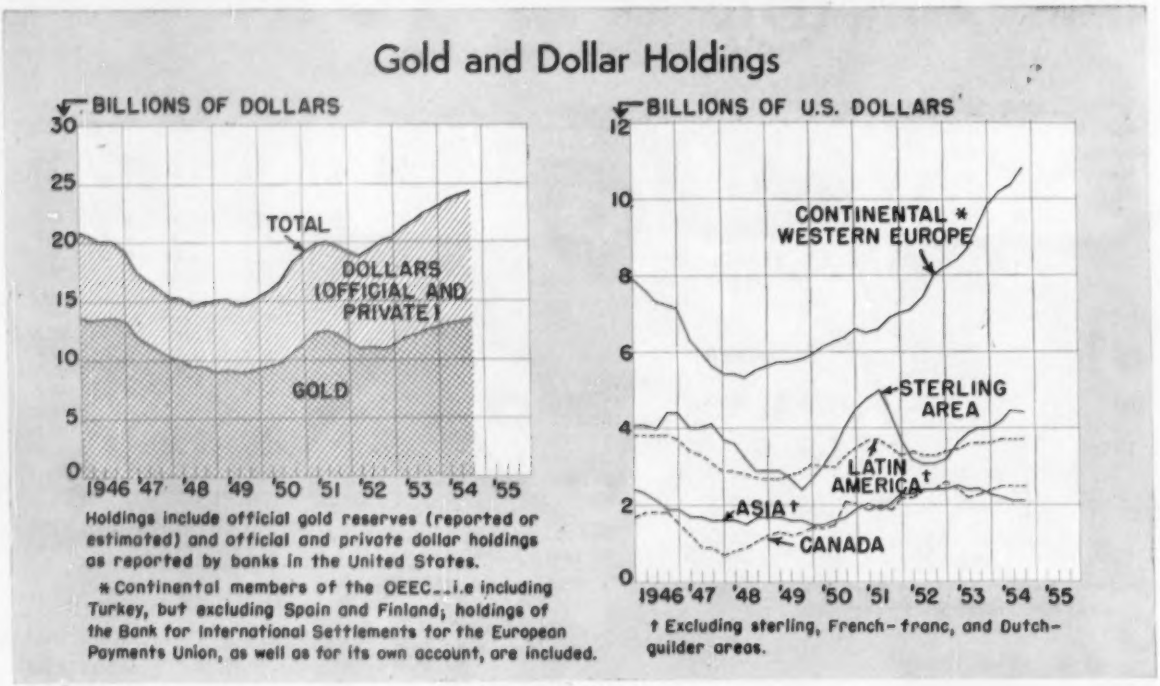
During the entire postwar period from 1945 through 1954 world gold output rose at an average annual rate of about 2.5%; the 6% rise last year was therefore much larger than during the earlier years. This rise reflected principally the expansion in South African gold production, which last year totaled some 13.2-million oz. This was a postwar record, some 11% above the production in 1953, which itself was only 1% higher than in 1952. A continuing rise in the output of the new mines of the Orange Free State and in the Far West Rand extensions of the Transvaal not only made good the decline in output in the older mines of Transvaal, but brought about a marked increase in South Africa's total gold output. Labor supply was more satisfactory in 1954 than for years past, and a gold output above the present level appears assured for the coming years.

Rise in the South African output accounted last year for over four fifths of the increase in the total world gold production. In Canada, where production had fallen around the end of 1953 because of labor difficulties in certain mining areas, output increased last year to some 4.3-million oz, or 5% above 1953; this, however, was still somewhat less than in 1951 and 1952.

In the U.S., gold production stood at about 1.9-million oz (on the basis of the first ten months) or about the same as in earlier years. In Australia, the Philippines, and India, on the Gold Coast and in Southern Rhodesia, and in Latin America, production remained, on the whole, stationary.

For the USSR, which, as already noted, is not included in the table or Chart I, estimates of gold output by non-Russian sources vary from 2-mil-

[1]The author is Chief of the Foreign Research Division, Research Department, Federal Reserve Bank of New York. The views he expresses are his own and are not meant to reflect those of the Bank.


Gold and Dollar Holdings
BILLIONS OF DOLLARS
30
25
20
15
10
5
0
TOTAL
DOLLARS (OFFICIAL AND PRIVATE)
GOLD
1946 '47 '48 '49 '50 '51 '52 '53 '54 '55
Holdings include official gold reserves (reported or estimated) and official and private dollar holdings as reported by banks in the United States.
* Continental members of the OEEC...i.e including Turkey, but excluding Spain and Finland; holdings of the Bank for International Settlements for the European Payments Union, as well as for its own account, are included.
BILLIONS OF U.S. DOLLARS
12
10
8
6
4
2
0
CONTINENTAL * WESTERN EUROPE
STERLING AREA
LATIN AMERICA†
ASIA†
CANADA
1946 '47 '48 '49 '50 '51 '52 '53 '54 '55
† Excluding sterling, French-franc, and Dutch-guilder areas.

lion to 9-million oz a year; a figure of 4-million oz is regarded by the Bank for International Settlements as probably being the minimum.

Gold-mining costs continued to rise last year but, so far as can be judged from available evidence, the rise was much less than in earlier years. In South Africa, the average working costs per ton milled rose 2% from January to October 1954; in 1953 the increase was 8%; in 1952 5%; and in 1951[1] 10%. Estimated working profits in the Transvaal mines remained at the 1953 level. The newly opened mines in the Orange Free State which operated at a loss in 1953, began to show profits last year and as a result total working profits in South African mines increased somewhat. In addition, certain South African mines derived larger profits than in 1953 from the extraction of uranium.

In Canada, higher-cost gold producers last year continued to receive a government subsidy provided they channeled their entire output into the official reserves; those who sold on the free markets had to forego this subsidy. Emergency assistance to gold mines will continue this year, but in what form, or to what extent, had not been officially announced at press time.

Gold producers last year sold a much smaller proportion of their output on the free gold markets than during recent years. The margin of profit offered on these markets narrowed since, beginning with the latter part of 1953, premium prices fell to the lowest level in approximately fifteen years; they stood close to the official parity, with minor fluctuations, throughout 1954. Under these circumstances practically the entire output of South Africa during the latter part of 1953 and the early months of 1954 was purchased by the South African Reserve Bank. When the gold market was reopened in London in March 1954, the authority granted to South African producers to sell gold on the free markets was withdrawn and the producers were again required to sell their whole output to the Reserve Bank. In Canada a larger number of gold-mining companies than in earlier years elected to sell to the Canadian Mint and receive a subsidy, instead of continuing their free market sales. In certain other countries, such as New Zealand, producers were relieved from the obligation to offer their entire output to the central bank, but the change in regulations had little practical effect.

Reduced "Gold Disappearance"

Newly-mined gold went into industrial uses, private hoards, or was otherwise unaccounted for, in much smaller amounts in 1954 than at any other time during postwar years, with the possible exception of the nine months from the world-wide currency devaluations in September 1949 to the Korean outbreak in June 1950.

The flow of gold from production into monetary and other uses can best be seen by tracing it separately in the U.S. and in the rest of the world. In the U.S., gold output last year was worth somewhat less than $70-million. On the other hand, gold consumption in industry, the professions, and the arts was of the order of $100-million, so far as can be judged from the experience of recent years; of this amount, same $30-million or so was supplied by the return of scrap gold. The net consumption in the U.S. was thus more or less equal to the current output, the difference, if any, being covered by drawings on, or additions to, the gold stock.

In countries other than the U.S., official monetary gold reserves (including those of the international financial institutions) increased during the year ended September 1954 by some $1,080-million. Of this amount, $385-million was purchased from the U.S.; as to the remainder, it was derived principally from purchases of gold from the USSR and from accruals from new production. Some gold held privately in certain countries may also have found its way into official gold

[1]Measured per oz of gold produced, the rise in working costs was, however, somewhat less than per ton milled: 10 per cent in 1951, 3 per cent in 1952, and 4 per cent in 1953; there was actually a fall of 1 per cent from January through October 1954, due to the increase in the gold yield in the newly opened Orange Free State mines.

holdings; but for the world as a whole, there does not appear to have been, on balance, any noticeable dishoarding last year.

Around the turn of 1953-1954 the USSR was reported to have sold, for the purpose of acquiring certain Western European currencies, varying amounts of gold either in the free markets in Western Europe, or directly to certain Western European central banks. The "Annual Bullion Review" of Samuel Montague and Co. put the acquisitions of Russian gold by Western European countries at some $100-million in the latter part of 1953; other sales were reported during the early months of 1954, but reports of such sales almost entirely disappeared from the world press during the rest of the year. Assuming that the Russian sales during the early months of 1954 were comparable with those during the latter part of 1953, Western European countries acquired perhaps up to some $200-million from the USSR during the period under consideration; at least a portion of this gold seems to have ultimately appeared in the official monetary reserves of the countries concerned.

Of the $1,080-million increase in official monetary reserves of countries other than the U.S. during the twelve months ended September 1954, $385,-million can accordingly be accounted for by purchases from the U.S. and perhaps $200-million by purchases from the USSR. The balance of some $500-million may therefore be regarded as having accrued from new production. Gold output in countries outside the U.S. (and outside the USSR) amounted to somewhat over $825-million during the year ended September 1954. It would thus appear that the equivalent of perhaps as much as three fifths of the current gold output in these countries found its way into official monetary reserves, as against only about one third from mid-1950 through the fall of 1953.

The difference of some $325-million between the gold output and the accretions to official monetary reserves can be accounted for by private uses of gold. The distinction between various private uses of gold—from genuine consumption in the arts and industry to hoarding as a traditional form of savings or as a hedge against monetary depreciation—was blurred during the postwar years to such an extent that the residual of gold output and the accretions to monetary reserves could best be treated merely as "gold disappearance."

Last year, however, this residual quantity of gold that could not otherwise be accounted for not only became much smaller than during earlier years, but with the weakening in propensity to hoard, noted below, a smaller portion of it may be regarded as having been hoarded than previously. Before the war, approximately the same amount of gold appears to have normally been used in the arts and industry in the rest of the world (excluding the USSR) as in the U.S. Today, in view of the fact that levels of employment and incomes in many countries are higher, in real terms and after allowing for the increase in population, than before the war, gold consumption outside the U.S. may very well be higher than the $100-million figure given above for the U.S. Should this be the case, well over one third of the $325-million worth of "disappeared gold" could perhaps be regarded as having been genuinely consumed in the arts and industry outside the U.S.

The reduced "gold disappearance" in 1954 thus contrasts sharply with the prolonged large-scale "disappearance" of earlier postwar years. The subsiding of "gold disappearance" last year seems to have reflected principally a decline in demand in certain countries of Western Europe—especially France—as well as in the Middle and Far East. This decline appears attributable in the West principally to the maintenance of financial stability and the resulting confidence in the national currencies; in France, where the hoarding demand is known to have been particularly large during the earlier postwar years, there was reportedly some dishoarding last year. In the East, relative stability of primary commodity prices, and hence of incomes, was probably the principal factor; but in certain Far Eastern markets some demand for gold persisted, presumably because of international political tensions in the area. The reduced demand for gold tended to keep the free-market gold prices of gold bullion around $35 per fine oz. The premium for gold coins over gold bars, although still appreciable, declined substantially last year.

Another important development was the reopening of the London gold market in March 1954, after a closure of almost fifteen years. The freedom in gold transactions that had existed in London before September 1939 has, however, not been restored. There are no restrictions on sales of gold, but purchases by British and other sterling area residents are subject to licensing, which is granted only for limited quantities of gold for trading and industrial purposes; residents of all other countries may buy gold only if payment is made in American Account or Canadian Account sterling (which has always been fully convertible into dollars) or in the so-called "registered sterling," issued only against dollars or gold itself, which was established for this purpose at the time of the reopening of the London gold market. The principal source of supply in the London market is the gold mined in the British Commonwealth, particularly in South Africa; but gold originating from other sources is also sold in London.

Reopening of the London gold market, as the British authorities stated, has in no way impaired the principle that gold should, as far as possible, be channeled into monetary reserves where it would readily serve balance of payments purposes, rather than into private hoards. The London market does not provide any facilities through which holders of inconvertible sterling can obtain gold and dollars. Nevertheless, it is an important step in the gradual restoration of the market mechanisms that are necessary for fuller currency convertibility.

Reserves Keep Growing

The gold reserves of countries other than the U.S. (together with those of the Bank for International Settlements and the European Payments Union) increased during the year ended September 1954 by $1-billion to $13.6-billion. The U.S. monetary gold stock declined during this period by $357-million to $21.9-billion; it stood at $21.8-billion at the year-end. The International Monetary Fund held $1.7-billion worth of gold in September 1954. Altogether, world monetary gold reserves (excluding those of the USSR) amounted to $37.2-billion in September 1954, as against $36.5-billion a year earlier. In September 1954 the U.S. thus held 59% of the world monetary gold stock, as against some 60% in 1945 and 70% in September 1949.

Besides gold, countries other than the U.S. held in September 1954 some $10.9-billion in the form of dollars, on both official and private account (including primarily deposits in U.S. banks and short-term U.S. Government securities, or $800-million more than a year previous. Total gold and dollar holdings of these countries in September 1954 amounted to $24.5-billion, or $1.9-billion above September 1953 (see Fig. II), and $3.7-billion higher than in December 1945 before the serious depletion of the earlier

postwar years. They were also $9.7-billion or 66% higher than in September 1949, the date of the general currency devaluations, and $5.6-billion or 30% higher than in March 1952, the post-Korea low.

The speed and extent of the gains in gold and dollar holdings varied from country to country, but with certain exceptions all major countries shared in it (see Chart III). The important exceptions were certain Far Eastern countries, particularly Indonesia, Japan and Thailand, as well as Brazil and Cuba in Latin America; the holdings of Latin America as a whole were slightly lower in September 1954 than a year previous. Canada's holdings of gold and United States dollars in September 1954 were US$245-million higher than in September 1953, reaching a record high. The holdings of Continental Western European countries increased by $1.5-billion during the twelve months; over one half of this rise went to Western Germany and Italy, but the reserves of Austria, France, and the Netherlands also increased. The aggregate gold and dollar holdings of sterling area countries increased by some $350-million during the year ended September 1954; in contrast to Continental Western Europe, where monetary reserves had increased continuously since 1951. The rise in the sterling area's reserves since mid-1952 marked a recovery from a sharp decline in the latter part of 1951 and early 1952.

The gold and official dollar holdings of the United Kingdom alone[1] stood at $2,901-million in September 1954, as against $2,486-million a year earlier. They fell to $2,762-million in December 1954, partly because of certain adverse seasonal movements, and partly because of the payment in December of $181-million under postwar debt and lend-lease settlement agreements with the U.S. and Canada.

The $1.9-billion gain in gold and dollar reserves of countries other than the U.S. during the twelve months ended September 1954 was, however, $0.6-billion less than the $2.5-billion improvement from October 1952 through September 1953. Furthermore, the gains in the year ended September 1954 were offset in part by an increase in foreign short-term liabilities to U.S. creditors of about $200-million. Such liabilities had actually declined somewhat during the year ended September 1953. Continental Western Europe was, however, an exception to this trend, as already noted, its gold and dollar holdings having increased from October 1953 through September 1954 by $1.5-billion, or some $200-million more than a year previous.

The decline in the rate of gold and dollar accumulation, as compared with 1953, does not, however, reflect a deterioration in the international payments position. On the contrary, it is a sign that in a number of countries reserves had become large enough to enable them to use sizeable portions of their current dollar receipts either to repay indebtedness or to relax restrictions on the purchases of dollar goods and services. For instance, the United Kingdom and certain other sterling area countries, as well as France, made voluntary repurchases of their currencies from the International Monetary Fund, and France and the Netherlands repaid, in advance of maturity, certain dollar loans. Several countries, including Belgium-Luxembourg, West Germany, Italy, the Netherlands, South Africa, and Sweden, substantially relaxed their dollar-import restrictions; in the United Kingdom, where many primary commodities from the dollar area had been freed from controls in 1952 and 1953, certain further relaxations were made last year, but manufactured goods remained generally subject to dollar-import restrictions.

Another reason for the smaller rate of accumulation of gold and dollar holdings by other countries was the reappearance of a U.S. export surplus on current account. This surplus—covering goods and services other than those provided under military aid, as well as emigrant and charitable remittances—amounted to $497-million during the first nine months of last year, in contrast to a $285-million deficit a year earlier. The reappearances of the U.S. export surplus was primarily the result of a $600-million decline in merchandise imports, and partly of a $100-million rise in exports other than those provided under military aid.

While the decline in U.S. merchandise imports was an important factor in explaining last year's slower rate of gold and dollar accumulation, the decline in business in the U.S. had, on the whole, little effect on the balance of payments position of the rest of the world. One reason for this was the considerable stability of prices for industrial commodities, which itself reflected basically the strength of demand for these commodities in Western Europe where industrial output showed a marked rise. The very fact that the American recession was quite moderate was another factor. The resumption of some U.S. stockpile purchases of certain metals, for instance tin, also contributed.

Last, but not least, the U.S. Government continued to purchase a large amount of goods and services abroad, including the so-called military offshore purchases of commodities that were donated by the U.S. as part of the military aid; and it also continued to grant economic aid, although in smaller amounts than in 1953.

The net outflow of United States private capital, particularly short-term funds, was much higher last year than in 1953, which also exerted a marked influence on the balance of payments positions of certain countries.

The general record of improvement in the international payments was not, however, without exceptions. Difficulties were serious in a number of countries of Asia and Latin America; they were accentuated, as a rule, by the sharp fluctuations in prices of certain primary commodities such as coffee, but in some of these countries they were also occasioned and intensified by the continuance of inflationary pressures.

Despite difficulties with commodity price fluctuations and inflationary pressures in a few countries, the Free-World economy as a whole appears distinctly stronger than a year ago. More particularly, industrial production in Western Europe reached an all-time record last year; and the output of many agricultural and industrial commodities in the primary-producing non-dollar countries also went up.

The continued increase in output was, of course, the fruit of earlier postwar investment efforts, but stronger budgetary positions and more appropriate monetary and credit policies also contributed importantly, along with more suitable exchange rates, to the re-establishment of self-supporting economies.

The non-dollar countries thus became less dependent on dollar imports, and this reduced dependence was one of the fundamental underlying forces working for a better international balance. Another important force was the general improvement in the competitive capacity of the principal trading nations relative to the U.S.

Altogether, therefore, last years' developments confirmed the hope that the strengthening of the Free-World economies, including the rebuilding of monetary reserves, could be successfully tested by fuller currency convertibility and lessened trade discrimination•

[1] I.e. sterling-area central reserves of gold and U. S. and Canadian dollars, as made public by the British Chancellor of the Exchequer.

TITANIUM

Thomas W. Lippert
Titanium Metals Corporation of America

AFTER FOUR YEARS of struggling with metallurgical unknowns and obstinate production techniques, the producers and processors of metallic titanium in 1954 scored encouraging gains with production of basic metal more than double the 1953 figure. More important were the impressive improvements in quality, the significant reductions in metal processing losses, and the evolution of a firm and documented physical-metallurgy pattern which assures in 1955 and 1956 many new and advanced alloys.

Production: Each of the two commercial producers of raw titanium sponge, Titanium Metals Corporation of America and E. I. du Pont de Nemours, achieved 10 tpd capacity production by late summer. Compared with a 1953 output of 2,250 net tons, total 1954 sponge production is estimated by Government agencies at 5,250 tons, of which TMCA and du Pont contributed about 2,500 tons each. The Bureau of Mines added 150 tons and other pilot units made up the remainder. Imports from Japan followed a rapidly rising curve; by mid-summer, the year's total being 250 tons, the major portion of quality metal originating in the Toho Titanium Co. plant at Chiagasaki City, Japan, a Mitsui enterprise.

The very sharp increase in sponge production late in the year brought about a seeming paradox of an oversupply of the material in face of repeated Government announcements that present and planned capacities are insufficient to meet requirements of the Air Forces alone. Actually, aircraft manufacturers cannot use titanium metal for any given application until assured of a sufficient supply to fill that application completely. Therefore, a sharp increase in production necessitates a temporary stockpiling of sponge by the Government such as that which occurred late in 1954. It is anticipated that all or part of the stockpiled sponge will be melted and converted during the coming year as additional applications are made in jet engines and airframe programs.

Price: The year was marked by substantial price mark-downs. In February, TMCA led off with reductions in sheet, strip and plate which in certain grades and sizes amounted to 12%, thereby establishing new market prices for those products. Lower market prices for bars and billets were set several weeks later when Rem-Cru Titanium, Inc. cut its prices for those products by as much as 14%. Sponge prices were also reduced during the year, initiated by Du Pont. The price of sponge was reduced from $5.00 to $4.72 per lb on April 1, and further reduced to $4.50 on Dec. 1.

The drastic tightening and retightening of customer specifications throughout 1954 was reflected in a succession of production upheavals. However, industry sources do not anticipate much further burdensome and costly narrowing of specifications in 1955, for titanium mill products are today moving under customer limitations of a rigidity not to be duplicated in other structural metals having decades of production history.

New Developments: The only new facility certain to contribute significant quantities of metal in 1955 will be Cramet, Inc., a Crane Co. subsidiary, which is constructing a 6,000-ton-per-year plant at Chattanooga, Tenn., under a contractual arrangement with the General Services Administration. The Dow Chemical Co. plant, Midland, Mich., under GSA contract for 1,800 tons annually probably will come in with pilot quantities during 1955, but likely won't approach capacity operation until late 1956.

One of the most significant new entries into the production field in 1954 was the Electro Metallurgical Co. division of Union Carbide & Carbon Corp. which late in the year completed negotiations with the Government for a 7,500-ton-per-year plant at Ashtabula, Ohio, and has announced late 1957 as its target for full production. Horizons Titanium Corp. is building a small electrolytic pilot unit at Stamford, Conn., under a Government research contract; Kennecott Copper Corp. has announced the likelihood of a 3 tpd semi-commercial plant; and there are rumors that Britain's Imperial Chemical Industries (which is constructing a 1,500-ton-per-year plant in England) intends to construct a facility in the U.S., possibly in affiliation with a yet unnamed U.S. company.

GSA has under active consideration a second contract with the Titanium Metals Corporation of America for an additional 5,400 tons per year at Henderson, Nev., and with E. I. du Pont de Nemours an additional 7,200 tons per year near Waverly, Tenn., and has under preliminary negotiation contracts totalling 20,000 tons per year with other interested and capable firms.

On the technological front, no new or particularly significant technique for producing the basic sponge metal has made its appearance. However, both Electro Metallurgical Co. and Imperial Chemical Industries have attracted considerable attention by reverting to a modification of the original method of producing metallic titanium, using sodium to reduce the tetrachloride, as against the magnesium (Kroll) reduction of the tetrachloride as practiced by TMCA, Du Pont and Cramet. The only fully-integrated facility operating or in the planning stage is TMCA which carries ore through the entire productive sequence to finished mill products, and is unique in that it recycles the by-products of reduction, i.e. chlorine and magnesium. In the melting of titanium sponge, double-melting and vacuum-melting techniques, announced early in the year by TMCA, are apparently becoming standard practice throughout the industry.

Outlook: While price reductions were decidely encouraging for such an infant industry, many trade observers look for even more significant declines in 1955, if the industry can continue its fast production and development pace and fully exploit current pilot operations leading toward full recycling of scrap metal.

For the past 5 yr titanium sponge production has at least doubled each year, and some sources indicate a possible doubling again in 1955, or an output of 10,500 tons. More conservative estimates list a likelihood of about 8,800 tons in 1955, with the possibility of 15,200 tons in 1956 and 22,500 tons in 1957.

That this new structural metal has so quickly attracted so many blue-ribbon American industrial firms into heavy technical and financial commitments is in itself a massive vote of confidence in titanium's future•

METALS

World Silver Production

Millions of oz	1950	1951	1952	1953	1954
Mexico	49.1	43.8	50.4	47.9	47.0
United States	42.3	39.9	39.8	37.7	37.0
Canada	23.2	24.2	24.4	28.3	31.0
Peru	13.4	14.9	19.2	19.3	20.0
Bolivia	6.6	7.2	7.1	6.1	6.5
Other South and Central American countries	7.0	6.6	7.1	8.8	7.5
Total Western Hemisphere	141.6	136.6	148.0	148.1	149.0
Outside the Western Hemisphere	57.0	62.0	62.2	68.3	65.0
World production	198.6	198.6	210.2	216.4	214.0

Treasury Silver

Millions of oz	Dec. 31 1950	Dec. 31 1951	Dec. 31 1952	Dec. 31 1953	Nov. 30 1954
Held in the Treasury:					
Securing Silver Certificates:					
Silver bullion	1,578.3	1,603.7	1,631.7	1,655.7	1,677.2
Silver dollars	241.9	232.8	223.8	215.2	208.0
Subsidiary coin	2.6	1.2	2.8	4.6	35.0
Free silver bullion	159.9	124.5	81.7	49.6	13.0
Total Treasury stocks	1,982.7	1,962.2	1,940.0	1,925.1	1,933.2
Outside the Treasury:					
Silver dollars	139.1	148.0	156.6	164.9	171.6
Subsidiary coin	739.4	783.5	837.7	877.5	898.0
Total silver outside Treasury	878.5	931.5	994.3	1,042.4	1,069.6
Total silver	2,861.2	2,893.7	2,934.3	2,967.5	3,002.8

SILVER

Francis H. Wemple
Handy and Harman

STABILITY was the outstanding characteristic of world silver markets throughout 1954. The New York price continued to have a strong influence on quotations in other countries, but evidence of growing independence in London and on the Continent developed during the year. Continuation of exchange and foreign trade controls in many countries has brought about changed relationships during the postwar decade, and today an important part of the world's silver business is being conducted through other than traditional channels.

Not since World War II has the New York silver market seen such a long period of price stability. The current published rate of 85¼c per troy ounce was established on Jan. 16, 1953, and it has remained at that level ever since. Furthermore, this unusual stability has been experienced under essentially free market conditions, although the price has been subject to considerable indirect influence by the silver policies of the Mexican and U.S. Governments.

Demand for silver in the U. S. dropped substantially in 1954, reflecting the slackening of business in many segments of the economy throughout most of the year. Total consumption in this country by the arts and industries amounted to about 85-million oz. This was 19% below 1953 and represents the lowest level of trade demand since 1941. More than half of total consumption was accounted for during the last six months of the year, representing a more normal seasonal pattern than in 1953 when conditions were in general the reverse.

The drop in demand in 1954 was felt in all lines, including many of the more important industrial uses. Reduced military purchases over the past year or more have resulted in a sharp curtailment in the production of many defense items consuming large amounts of silver, particularly in the form of brazing alloys. In addition, at the beginning of the year, inventories of consumer durable goods, such as refrigerators, air-conditioning units and other electrical appliances, were high. This resulted in reduced production rates for these items, which in turn further restricted the demand for industrial silver alloys. These adverse developments, however, resulted from adjustments in our economy which by nature are temporary. Advantages of silver, both for performance and economy, have brought about a steady expansion in the number and types of its applications in the manufacture of a wide variety of products. In recent years the consumption of silver in industry has exceeded in volume the more traditional uses in the arts.

Total imports of silver into the U.S. during 1954 amounted to about 92-million oz, a decline of 7.2% from 1953, with the Western Hemisphere accounting for 83% of the total. Outside the Western Hemisphere, the largest shipment to the U.S. was approximately 11-million oz from The Netherlands. This silver was consigned to the Philadelphia Mint and is ultimately to be credited to that country's lend-lease obligation.

Total exports amounted to approximately 4-million oz. Great Britain received about 1,500,000 oz., representing a moderate revival of business

Silver Imports and Exports of the U. S.

Millions of oz	1953	(Est.) 1954
Imported from:		
Canada	20.6	21.6
Mexico	26.1	30.0
Peru	13.7	15.0
Bolivia	4.1	4.2
Cuba	17.6	.2
Other Western Hemisphere countries	7.6	5.4
Total Western Hemisphere	89.7	76.4
The Netherlands	3.1	11.0
United Kingdom	.5	.2
Other European countries	1.2	.4
Japan	2.3	1.0
All other countries	2.3	3.0
Total imports	99.1	92.0
Exported to:		
Canada	.3	.1
Cuba	5.2	...
Mexico	...	...
United Kingdom	...	1.5
All other countries	.7	2.4
Total exports	6.2	4.0

World Silver Consumption

Millions of oz	1950	1951	1952	1953	1954
Arts and industries:					
United States	120.0	110.0	95.0	105.0	85.0
Western Germany	7.6	10.0	10.4	17.5	24.2
Great Britain	12.4	16.6	9.1	11.5	12.2
France	1.3	10.4	10.5	10.5	10.5
Japan	....	3.5	3.5	5 6	5.8
Canada	5.2	4.4	3.8	4.4	3.9
Other countries	10.9	6.7	6.3	9.3	10.5
Total	157.4	161.6	138.6	163.8	152.1

Millions of oz	1950	1951	1952	1953	1954
Coinage:					
United States	24.6	44.4	57.3	42.7	54.0
Saudi Arabia	....	20.6	23.0	....	....
Western Germany	....	.3	14.1	....	....
Mexico	3.8	4.8	7.1	14.1	....
Canada	3.4	3.1	3.0	3.9	1.8
Belgium	5.7	5.8	....	2.3	1.5
Other countries	6.6	11.5	9.8	11.7	10.0
Total coinage	44.1	90.5	114.3	74.7	67.3
Total consumption	201.5	252.1	252.9	238.5	219.4

between these two countries. Shipments to other countries totaled 2,500,000 oz, the most important of these being a coinage order of 1,500,000 oz executed for El Salvador at the San Francisco Mint.

Silver stocks of the U.S. Treasury, in bullion and coin, increased by 8,100,000 oz to 1,933,200,000 oz during the first eleven months. Outside the Treasury, silver dollars and subsidiary coin in circulation at Nov. 30 amounted to 1,069,600,000 oz, up 27,200,000 oz from the first of the year. Treasury acquisitions during the eleven months period totaled 37,200,000 oz, of which 30,500,000 oz consisted of newly mined domestic silver received under the Act of July 31, 1946. During this same period the Mints consumed 52,300,000 oz in the production of subsidiary coin, a major portion of which has not yet been put into circulation.

Un-monetized bullion in the Treasury, usually referred to as free stocks, continued to decline as the result of the Treasury's coinage program, and at Dec. 31, 1954 amounted to 13,700,000 oz, compared to 49,600,000 oz on Jan. 1. At this rate of withdrawal free stocks will soon be exhausted. However, the Treasury had on hand at the year end some 34,500,000 oz in subsidiary coin, which would seem ample for present needs.

Lend-lease silver: Return of 11-million oz by The Netherlands has already been referred to. This advance repayment from the third largest debtor was a significant market development. Since this silver has not been officially credited, it is not yet known how it will be accounted for by the Treasury, but it will constitute an important addition to free stocks. Furthermore, it now seems more probable that other major debtors will repay their obligations on schedule.

One must look to Mexico for the key to the stability of the silver market. Throughout 1954 the Bank of Mexico maintained its established policy of buying Mexican production as offered and of selling freely to buyers both here and abroad. The unchanging price in New York was the direct result of this policy.

A brief analysis will demonstrate how Mexico can exert such a dominant influence. The U.S. and Mexico are the two largest silver producing countries in the world. With the production of the U.S. absorbed entirely by the Treasury, the market here depends on supplies from Mexico for a substantial portion of its requirements. Through buying and selling its own output in response to changing conditions, Mexico can adjust supplies with a high degree of accuracy. However, it is important to note that the Bank of Mexico did not find it necessary to accumulate silver during 1954 to accomplish its objective. Official stocks increased to be sure, but this increase was the result of withdrawals of demonetized coin. From its market operations alone, the Bank actually sold silver on balance by a small margin.

Total acquisition by the Bank of Mexico during 1954 amounted to about 31,500,000 oz, and sales totaled 25,200,000 oz. This would indicate an increase of about 6,300,000 oz in official stocks of the Bank, which we are advised amounted to about 35-million oz at the year end. About 24-million oz of total acquisitions represented purchases of Mexico's own production, and 7,500,000 oz were obtained through withdrawal from circulation of demonetized coin. About 12-million oz were sold either directly or indirectly for delivery to the New York market. Sales to Western Germany increased considerably from the past year and amounted to 10,700,000 oz. France bought 2,200,000 oz, and small purchases by Guatemala and Chile accounted for the balance.

World production in 1954 amounted to about 214-million oz. Of this total, the Western Hemisphere accounted for 149-million oz with Mexico and the U.S. remaining the most important factors. However, Canada's output has been expanding steadily over the past several years and today is approaching the two leading countries in importance as a source of supply. Outside the Western Hemisphere, Australia accounted for about 11,500,000 oz, Japan about 6,900,000 oz, the Belgian Congo about 5-million oz, and Western Germany about 3,700,000 oz. Information for other countries is conjectural, but a figure of 65-million oz seems reasonable for total production outside this Hemisphere.

Consumption of silver in the arts and industries throughout the world totaled about 152,100,000 oz, a drop of 70% from the previous year. Actually in many countries consumption was higher than in 1953, but these increases were more than offset by the sharp drop in the U.S. World consumption for coinage also declined and amounted to about 67,300,000 oz, down 10% from the previous year. Based on these estimates, world silver consumption for all uses amounted to about 219,400,000 oz.

Forecast: Prospects for the silver market today are substantially the same as they were a year ago. The forces affecting price continue to be static, and there have been no developments of sufficient significance to change basic conditions. There will probably be some improvement in trade demand in the coming months along with the widely anticipated increase in economic activity in general. On the other hand, there is no reason to believe that supplies will fall short of requirements.

It must be emphasized, however, that a forecast for silver is subject to legislative developments in Washington and to any change of policy on the part of Mexico•

Aluminum—World Production

(Thousands of tons)

	1952	1953	1954
United States	937	1,252	1,461
Canada	500	546	561
Western Europe	463	496	562
Asia & South America	57	67	70
Free World total	1,957	2,361	2,654
U. S. S. R. & Satellites	321	381	466
World total	2,278	2,742	3,120

Aluminum Supply in U. S. Markets

(Tons)

	1952	1953	Est. 1954
Net domestic primary supply*	938,181	1,219,970	1,454,000
Imports, less exports	126,845	298,552	238,000
Aluminum recovered from old scrap	71,264	78,940	62,000
Total supply	1,136,290	1,597,462	1,754,000

*Domestic primary production, adjusted for net annual changes in producers' stocks.

ALUMINUM

Irving Lipkowitz
Reynolds Metals Co.

These are the 1954 highlights in aluminum: Domestic producers set new record for third successive year. Russian reported output shows sharpest rise. Net imports off as scrap exports jump sharply. Total aluminum supply exceeds copper supply on tonnage basis. Military consumption cut in half, civilian consumption hits new peak. All major markets continue to grow, with foil sales 30% higher than last year. Outlook bright for 1955 with ample domestic supply in sight and the prospect of larger markets•

Primary Production: For the third successive year the domestic primary producers set a new output record. 1,460,587 tons were produced in 1954, 17% above the 1,252,015 ton output of 1953.

Expansion of primary capacity begun by the present domestic producers during the Korean War was completed during 1954. Only one primary producing plant is still under construction—the 60,000-ton facility being built by Anaconda Aluminum Co. which expects to produce its first aluminum in 1955. As anticipated, the completion of the expansion undertaken by the producers because of the Korean emergency has doubled the nation's annual primary aluminum production, which amounted to 718,627 tons in that year (1950).

Primary production in the rest of the world increased in about the same proportion as it did here, rising 11%, from 1,490,000 tons in 1953 to an estimated 1,659,000 tons in 1954. Consequently, the U. S. share of world output was 47%.

The relative position of major producing areas, other than the U. S., is changing, although each of them increased their output during 1954. Significantly, Russia and its satellites seem to be improving their relative position among the world's aluminum producers more than any other group. Their primary output for 1954 is estimated at 466,000 tons, amounting to a 22% jump over 1953. On a tonnage basis, their 1954 increase of 85,000 tons over 1953 is 40% more than half that of the U. S. but more than the tonnage gains of Canada and Western Europe combined. Although the Russian group still is in fourth place among the world's major producing areas, their reported 1954 rise in output brings their share of world output to 15%, as against 14% for 1953.

Initial units of Canada's new producing plant at Kitimat, B. C., went into production during the summer of 1954. Canadian primary output for 1954 is estimated at 561,000 tons, about 3% above the 1953 level. Western European estimates for 1954 indicate about a 13% increase, from 496,000 to 562,000 tons.

Bauxite Production and Imports: Growth of the aluminum industry has stimulated a corresponding increase in bauxite mining. Domestic mine production, almost all of it from Arkansas, is expected to set a new peacetime peak of 1,900,000 tons in 1954. This is 20% higher than the 1,580,000 ton output in 1953. Imports show a still sharper increase, about 20% over the previous year. Total imports were actually 5,300,000 tons for 1954, or 74% of total U. S. supply. On the import side, too, 1954 reached a new peacetime high.

Surinam, still the principal source of foreign bauxite by a wide margin, accounts for probably less than 60% of the 1954 imports although it provided over 75% of the 1952 and 1953 imports. Jamaica and British Guiana shipments have increased in relative importance, with the receipts at U. S. ports from these two countries for the first nine months of 1954 already exceeding the totals for the full year of 1953. Active development of the bauxite deposits in Haiti is also progressing.

In practice, domestic and foreign ores are complementing each other. Some of the high-grade imports are being blended with domestic low-grade bauxite in processing the ore into alumina. On a blended basis it becomes possible to use certain domestic deposits which by themselves could not be used economically. Foreign ores are consequently instrumental in widening the range of commercially usable domestic deposits.

Aluminum Imports and Exports: Foreign aluminum shipments to this country were lower in 1954 than in 1953. The principal reason was the abundant and increased supply of all aluminum products from domestic sources throughout the year. Another factor was improved economic conditions in foreign countries, enabling them to absorb more of their aluminum products in home markets.

Imports of scrap and fabricated aluminum declined more sharply during 1954 than did primary aluminum ingot. In the case of scrap, imports were about 53% below 1953 levels and fabricated aluminum imports were a little less than half as large as they were in 1953. Primary ingot imports, however, were in the neighborhood of 28% lower in 1954 than in 1953. European primary shipments here dropped off sharply and Canada's shipments were 18% lower in 1954 than in 1953.

Exports of primary and scrap aluminum, were higher in 1954 than in 1953. The most significant in-

crease was in scrap exports. For the first nine months of 1953 scrap exports totaled about 850 tons. But during the same period last year, 30,200 tons were exported. The sharp rise began in October 1953 and shot up so rapidly that the total for the last quarter of 1953 was 3½ times as large as the total for the first three quarters combined. In an effort to curb these exports, effective June 11, 1954, export licenses were issued only on the basis of firm purchases. Although there has been some decline in scrap exports since July, the 1954 total was still eight times that of 1953.

Total United States Supply and Shipments: Total supply of aluminum available in the United States from all sources during 1954 also set a new all-time high, aggregating about 1,714,666 tons. The 1954 supply was 6% above that available the year before and 50% more than in 1952. During 1954, the 17% rise in domestic primary production was partially offset by the decline in imports and the rise in exports, especially of scrap. The high scrap exports also resulted in a reduced supply of scrap for domestic consumption.

A comparison of 1954 supply with the shipments to all consuming industries, as estimated by the United States Commerce Department and summarized above, indicates that the 1954 net domestic primary supply alone was more than sufficient to provide the total estimated military and civilian shipments of 1,450,000 tons. A highlight of the U.S. supply picture is the marked rise of domestic primary metal from 75% of the total in 1953 to 85% in 1954. Net imports fell from 20% of the 1953 supply to 11% in 1954. The remaining supply came from old scrap.

The 1954 record supply of aluminum made metals history also because for the first time it exceeded the year's copper supply *ton for ton*. Copper supplies, computed on a comparable basis, were estimated at about 13% below 1954 aluminum supplies. The relationship between the two metals has changed markedly over the years, as the accompanying fifteen-year record shows.

In terms of actual usage, the relative growth of aluminum supplies is even more pronounced since a pound of aluminum has more than three times the cubic volume of a pound of steel or copper and in electrical conductivity, for example, is equivalent to 2 lb of copper. On a volume, or cu ft basis, the 1954 aluminum supply was more than 50% greater than the *combined* volume of the copper, lead and zinc supply.

Aluminum vs Copper

Year	Total U. S. supply (tons) Aluminum	Copper	Base price per lb. Aluminum	Copper
1940	287,500	1,342,700	18.8c	11.4c
1945	726,000	1,912,000	15.0	11.9
1950	983,000	1,932,000	17.7	21.5
1954	1,754,000	1,563,000	20.2	29.9

Total aluminum shipments to consuming industries in the U. S. during 1954 were 1,450,000 tons, according to U. S. Commerce Department estimates. The 1954 total was about 150,000 tons below 1953, a record year. The decline in 1954 was entirely the result of a 57% cut (200,000 tons) in defense shipments from 350,000 tons in 1953.

Shipments to civilian markets set a new record in 1954, at 1,300,000 tons, or 50,000 tons above the 1953 level. Civilian shipments rose from 70% of the industry's total in 1952 to 90% in 1954. This new peak in civilian consumption is attributed partly to the fact that 1954 was the first full year that the aluminum industry had adequate domestic supplies to meet all of its market requirements and it was the first full year of freedom from Government controls limiting civilian usage.

The relatively high level of 1954 aluminum shipments reflects a sharper recovery during the year than characterized most of the basic industries Towards the end of the year, aluminum shipments were 23% higher than in January, while the general business index showed only a 5% rise over the same period.

Market Development: The industry's emphasis on market development and new applications continued strong in every major market throughout 1954. Creation of additional primary capacity to meet mobilization objectives coupled with a sharp cut in actual military consumption during 1954 created a strong incentive for the industry to make an aggressive drive for new and larger civilian markets.

Price relationships also continued favorable to market development. There was a slight increase in the base price from 20c to 20.5c for primary pig. The new price went into effect during the summer to compensate for some of the industry's increased costs, resulting from wage rises granted at that time. Fabricated aluminum prices showed varied increases, depending on the relative impact of the wage rise on the particular product as well as its market strength.

Building and construction, aluminum's major market, continues to grow. Each year aluminum windows account for a larger share of the new installations. The trend towards air conditioning has also stimulated the use of aluminum in buildings because of its insulating and rustproof features. Aluminum has become the principal metal used for store fronts and is becoming increasingly popular for exterior panels of commercial and industrial buildings.

The automotive industry continues to increase its aluminum consumption per car. During 1954, about 35 lb of aluminum were used per car, as against 8 lb in 1945. One of the leading brands of automobiles averaged about 65 lb per car on its 1954 models. A major development has been the use of aluminum in automotive applications for exterior and interior trim, instead of just under the hood and in the transmission. Improved finishes available on aluminum, plus the public's increased familiarity with aluminum, have stimulated this trend.

On the farm, a major 1954 development was the rapid nation-wide adoption of aluminum pipe for sprinkler-irrigation. Irrigation systems are being used in all parts of the country to provide "drought insurance" and to assure stability and adequacy of water supply. Crop yields have shown sharp improvement. Corn fields formerly producing 25 bushels per acre jumped to 80 bushels with sprinkler irrigation. Alfalfa fields have doubled their yield. Vegetable growers have been able to plan production on the basis of assured water supply, instead of being entirely dependent on rainfall conditions.

A new use for portable aluminum pipe is as temporary oil, gas and water lines to drilling rigs in oil fields. Extruded 2⅞ in. aluminum pipe—the

same diameter as the steel pipe it replaces—with special quick couplings are used. Actual installations proved that the aluminum pipe could be laid down and picked up again about 10 times as fast as steel pipe of the same diameter and length. The difference in weight is a major time-saver, with a 30-ft section of the aluminum pipe weighing only 30 lb as against 200 lb for the same length of steel pipe. In Texas, rental companies have been established which will rent installed pipelines to oil drillers and construction firms for as long as they are needed on the job.

Aluminum foil markets have set new records in 1954, with shipments about 30% above 1953 levels. Labels and foil packaging, printed in color, are being used by more food packers, breweries and beverage bottlers than ever before. The steady development of supermarkets and giant shopping centers has increased the need for such packaging which can act as silent salesmen on the open shelves and counters.

Direct consumer use of aluminum has also set new records. Household foil is firmly established as a staple in millions of homes. Cooking and food wrapping for refrigeration are still the major uses but aluminum foil is being used for holiday decorations, gift packaging and a growing variety of other household purposes. The do-it-yourself trend has also brought aluminum into many home workshops where it is being used in the form of sheets, tubing, rod and extrusions.

The popularity of metallic yarns in textiles has developed another specialty market for aluminum foil. Very narrow strips of colored foils in conjunction with various fibers and plastics are used to make a variety of metallic yarns.

Stockpiling and Military Requirements: Deliveries to Government aluminum stockpiles during 1954 have been reported by Washington to have exceeded those of any other year. The principal reason is that in addition to the tonnage purchased at the initiative of the stockpile procurement authorities, large tonnages of primary aluminum have been proffered by the domestic producers pursuant to their expansion program contract with the Government.

After military requirements for mobilization purposes were reviewed during 1954 by defense authorities the Office of Defense Mobilization decided to cancel the "third round" of aluminum capacity expansion which had been originally announced in October 1952. The expanded United States capacity, increased tonnage flowing into the stockpile, and the availability of imports from Canada, as well as the revised requirements estimates, were cited by ODM as the basis for the cancellation.

New Alloy Designation System: Effective Oct. 1, the aluminum industry adopted a uniform alloy designation system for wrought aluminum products. Developed through the Aluminum Association, the new uniform system simplifies the problem of alloy designation, codes the designation to the chemical composition of the alloy and eliminates many of the previous causes of confusion among producers and consumers.

Price change: Effective January 10, 1955, Reynolds Metals raised its price for primary aluminum 1c making the price 21½c for pigs and 23.2c for ingots. Kaiser followed, effective January 12, Alcoa on January 13, and Alcan went along on January 14.

Outlook: A plentiful domestic supply of aluminum is in prospect. Primary aluminum production in 1955 is expected to rise slightly to about 1,500,000 tons if water power conditions are as favorable as in 1954. It would mark another all-time high, the fourth in as many years. Production in the rest of the world is also expected to rise, particularly in Canada and in Western Europe. Foreign supplies available for export to the U. S. should therefore be as large or larger than they were in 1954.

The long-range supply outlook is also promising. Although ore consumption has shown a sharp increase, there seems to be no danger of any shortage. World consumption of bauxite during the past three years equaled the tonnage consumed during World War II and was also equal to the tonnage used during the entire 40-yr period from the beginning of the century to World War II. Known bauxite reserves have been increased, nevertheless, by more than 1-billion tons since the start of World War II. This means that about ten tons of new reserves have been added to the world supply for every ton being mined. Beyond these bauxite reserves, there is a vast domestic reserve of high-alumina clays which are coming closer to commercial usefulness as the industry finds it possible to use lower and lower grades of bauxite.

Market development is also expected to be vigorous. Aluminum is a long way from any saturation point in major markets, such as construction, automobiles, railroads, electrical appliances and packaging. In each case it has good prospects of increasing its relative position. Just as the expansion of primary production, precipitated but not absorbed by the Korean War, created a supply which stimulated the industry to set a new civilian shipments peak in 1954, so it is expected that military-pressured developments on the fabricating front will help to create new civilian markets.

A new all-aluminum truck developed by Chrysler illustrates what is in prospect. Designed for airborne operations, this 2½-ton truck weighs 6,000 lb less than the conventional Army truck carrying the same load. The 40% saving in weight results from using an all-aluminum body, cab, wheels and axles. Capable of speeds over 60 mph and climbing a 60% grade, development of this experimental truck has already influenced design of military trucks produced in volume.

The railroad equipment market is expected to grow for aluminum as a result of the interest being shown by leading U. S. railroads in possibilities of adapting the Talgo-type passenger train to American requirements. Two of these trains, with all-aluminum car bodies, have been averaging 50 mph on the 400-mi run from Madrid, Spain, to the French border, much of it through mountainous country. Trains of the conventional, heavier metals would take 12 instead of 8 hr to make this trip.

Rapid development being made in aluminum finishes and colors is expected to bring added interest from the construction and appliance industries, as well as the automobile manufacturers. The favorable price relationship of aluminum to copper is expected to continue, with its cumulative effect on the shift from copper and brass to aluminum in electrical and other applications.

The strong recovery of the aluminum industry during 1954, after the general business decline in the latter half of 1953, makes it strongly optimistic about 1955. The widely predicted continued improvement in general business conditions, plus the prospect of an economical and abundant aluminum supply, reinforce the view that 1955 should be an excellent year for aluminum production and sales•

MAGNESIUM

J. D. Hanawalt
Dow Chemical Co.

TOTAL PRIMARY MAGNESIUM production in the U. S. in 1954 was 73,000 tons. Consumption in the U. S. was distributed about equally between military and commercial applications and was about 7% less in 1954 than in 1953. It is estimated that there will be an increase in consumption of about 20% in the coming year. This would make 1955 the largest peacetime year in the history of the magnesium industry.

Two developments attaining production proportions in the past year can be singled out as promising major impacts on the magnesium industry. The first is in the wrought magnesium field and the second in the magnesium die casting field.

Magnesium Mill Products

Dow Chemical Co.'s Madison Division magnesium mill added a significant amount to the mill product capacity of the country. In 1953 an 84-in. hot mill was placed in operation. 1954 saw the successful operation of the 84-in. finishing mill and various other mills along with production coiling of magnesium sheet. Important consequences of this modern mill capacity were the price reductions of from 10 to 25% in sheet and plate and the availability of these materials in a wider range of products and sizes. Extrusion presses up to 5,500-tons were in full operation. 1955 will see the completion of a 13,200-ton press, capable of producing extruded shapes heretofore unavailable.

This advance in the competitive position of magnesium mill products has resulted in significant developments in the industry.

In the consumer field, an example is the use of magnesium sheet and extrusions in the new line of Samsonite luggage produced by Shwayder Brothers of Denver, Colo. Engineers tested many possible basic materials for luggage construction, including aluminum, plastics, fiberglass, and magnesium. Magnesium was selected as the best material because, in these comparisons, it provided the optimum combination of light weight, resilience and rigidity. These tests covered laboratory observation of the amount of impact energy that could be absorbed without permanent deformation, as well as measurements of toughness and other structural characteristics. Finally, this superior combination of dent resistance and lightness was confirmed in extensive flight tests of finished, vinyl-covered magnesium luggage. These serviceability characteristics of magnesium which have been well recognized in other applications are becoming available for the first time in the highly competitive consumer field.

In the industrial field, where new prices and availability of magnesium mill products are resulting in increased usage, a good example is the commercial highway transportation industry. Here, also, it has been recognized that magnesium design and serviceability characteristics show to advantage. Custom van truck body builders now have available a new line of magnesium sheet and extrusions for building bodies that combine light weight with ruggedness that surpasses even the heaviest of conventional steel models.

More evidence of magnesium's progress in becoming one of the common structural metals is its availability in all standard mill forms from warehouses throughout the country from New York to Los Angeles. In 1953 only two warehouses were becoming established. 1954 and 1955 will see this distribution extended to more than a dozen locations in the U.S.

Magnesium Die Casting: In the field of process development, 1954 saw the commercial attainment of a submerged plunger, or "hot chamber" process for die casting magnesium. The new process, involving automatic transfer of magnesium from the melting pot to a reservoir on the machine and thence into the die, permits higher rates and more economical production of magnesium die castings. Rates of production from 150% to 400% higher than those of the conventional cold chamber process have been attained. This development permits completely automatic production of simple, symmetrical parts. In practice, with relatively complicated castings, the operator starts each casting cycle with a control button and removes the cast from the die; however, with automatic metal transfer, the hand ladling the non-ferrous metal mining industry tor can concentrate on his primary function—production of good castings.

This new technology is being disseminated throughout the die casting industry and a great deal of interest and enthusiasm is evident.

On the basis of present prices, the metal cost per piece of a magnesium die casting is less than for other common die casting metals.

It is anticipated that in 1955 the portable tool, business machine, household appliance and automotive industries will be large consumers of magnesium die castings. At the present time, there are approximately 50 production magnesium die castings being used on current automobiles, and designs now on the planning boards will utilize even greater numbers. Structural parts of the Volkswagon automobile engine, manufactured in Europe, use approximately 35 lb of magnesium per car. This has been practiced in Volkswagon design for more than 10 years and present manufacture of the car for domestic and export consumption is greater than ever before.

Other Developments: Also of note in the automotive field is the continued interest in magnesium for wheels. Magnesium wheels were first utilized on three cars in the 1950 Indianapolis Speedway Race. In 1954, magnesium wheels were used on all cars that finished in the famous race. Commercially, magnesium wheels are being developed for trucks and cars.

The Dow Etch process for photoengraving magnesium sheet and plate continues to fulfill its promise. This process, announced in 1953, has shown an 83% increase in growth during 1954 and it is anticipated that it will grow at a more rapid rate in 1955. The development is based on a unique combination of structural and etching characteristics of magnesium and is applicable in book, business forms, label and newspaper printing fields.

New high temperature alloys depending on thorium and rare earths for their properties continued to arouse great interest in engineers, especially for high speed aircraft. In 1954 these new high temperature alloys were not only introduced for castings but also as sheet and extrusion alloys. It is anticipated that their importance will continue to grow.

Titanium production is another field in which the utilization of magnesium continues to increase at a rapid rate. Most of the present planned production plants for titanium utilize magnesium as the reducing agent for titanium tetrachloride•

Copper Statistics

The following copper statistics, reported by Copper Institute, account for most of the world's production that has a direct bearing on the market. Totals exclude the USSR and countries behind the Iron Curtain, as well as a few countries of minor importance.

Short tons	1947	1948	1949	1950	1951	1952	1953	1954
UNITED STATES								
Primary production	871,391	850,088	772,986	940,249	964,589	961,886	957,318	863,939
Secondary production	105,307	130,410	135,052	117,439	56,910	46,003	110,475	102,545
Refined production	1,196,393	1,233,697	1,056,463	1,270,768	1,199,784	1,189,112	1,395,003	1,311,249
Deliveries to fabricators	1,383,666	1,344,445	1,031,595	1,371,464	1,367,787[a]	1,445,834[a]	1,443,719[a]	1,206,692[a]
Stocks refined Dec. 31	76,035	96,080	116,027	49,040	71,528[b]	58,858[b]	89,193	47,108
OUTSIDE UNITED STATES								
Primary production	1,229,825	1,271,884	1,270,529	1,347,356	1,378,833	1,401,001	1,441,874	1,494,693
Secondary production	8,995	8,526	10,241	11,387	5,360	9,583	13,238	5,273
Refined production	1,016,856	1,072,229	1,076,114	1,127,329	1,225,018	1,196,426	1,120,066	1,155,928
Deliveries to fabricators	921,851	901,073	933,641	898,601	1,013,450	1,005,259	831,441	1,247,120
Stocks refined Dec. 31	143,979	175,669	147,972	139,919	152,203	130,103	280,530	181,529
COMBINED TOTALS								
Primary production	2,101,216	2,121,972	2,043,515	2,287,605	2,343,422	2,362,887	2,399,192	2,358,632
Secondary production	114,302	138,936	145,293	128,826	62,270	55,585	123,713	107,818
Refined production	2,213,249	2,305,926	2,132,577	2,398,097	2,424,802	2,385,538	2,515,069	2,466,277
Deliveries to fabricators	2,305,517	2,345,518	1,965,236	2,270,065	2,381,237	2,451,093	2,275,160	2,453,812
Stocks refined Dec. 31	220,014	271,749	263,999	188,959	223,731	188,961	369,723	228,637

[a]Includes tonnages delivered from government stocks. [b]Includes tonnages delivered to U. S. consumers at foreign ports.

COPPER

H. H. Wanders
Market Editor

AN UPWARD TREND in world mine output of copper was interrupted in 1954 because of curtailment in production early in the year and by an unexpected series of strikes at important operations in the U. S. and in Chile.

The year got off to a slow start, with sentiment mostly bearish. In fact, copper for forward delivery was available outside of the U. S. at a substantial discount from going quotations for prompt metal. Stocks of copper at the producers' level were large and fabricators were engaged in reducing inventories. Before the year ended the picture changed radically. There was a world-wide scramble for copper and demands could not be satisfied. U. S. fabricators again were increasing their inventories, in part for tax purposes.

Except for scattered offerings of copper by custom smelters in the first quarter of 1954 at a shade below 30c, the selling basis in the U. S. was kept on an even keel throughout the year. The *E&MJ* average for domestic copper for 1954 was equivalent to 29.994c, delivered.

Pricewise, the foreign market was erratic. On occasions the daily spread in prices on sales reported to *E&MJ* amounted to as much as 8c per pound. However, the bulk of the sales closed on a flat-price basis in the foreign division at all times was nearer the lower limit of the spread, with the result that our average price for the year turned out to be 29.964c, f.a.s. N. Y. equivalent, a shade below that of the preceding year.

Reduced consumption in the U. S. was offset by an appreciable rise in the use of copper outside of this country, chiefly Europe. With trade opening up abroad, due to increased industrial activity and the relaxation of controls on the movement of copper products to countries behind the Iron Curtain, foreign demands were even larger than anticipated. The United Kingdom absorbed 351,700 tons of refined copper in the nine months ended September, against 359,600 tons for all of 1953. West Germany consumed 261,800 tons in the Jan.-Sept. period of 1954, against 237,300 tons during all of 1953. France used an estimated 117,500 tons in the nine months, which compares with 118,400 for all of 1953. The trend toward self-sufficiency lifted consumption in Latin America, Africa and Asia.

Producers' deliveries of refined copper to U. S. fabricators showed a reduction in 1954 of about 20% compared with 1953. On the other hand, shipments of copper products by domestic fabricators to their customers were down by only 10%. The month-to-month record of producers' deliveries and fabricators shipments (copper content), in tons, follows:

	Apparent Consumption	
	Producers' deliveries	Fabricators' shipments
January	77,091	100,805
February	89,017	94,975
March	95,795	103,796
April	104,579	104,693
May	111,005	102,810
June	106,252	104,651
July	97,436	80,751
August	92,475	102,966
September	89,198	106,628
October	105,293	116,232
November	118,925	114,392
December	119,626	97,196
Totals	1,206,692	1,229,777

U. S. fabricators reduced their stocks of refined copper during the last year by 20,000 tons.

To supply the domestic market with its large requirements, the U. S. again

had to draw on outside sources for much of its copper. With Europe bidding for more and more copper, frequently at prices well above the U. S. selling basis, it was natural that offerings of foreign metal for domestic consumption would tend to diminish. In the ten months that ended with October, net imports of copper averaged 30,781 tons a month, which compares with an average of 46,606 tons for all of 1953.

A summary of the latest official figures on U. S. imports and exports, in tons, follows:

	Year 1953	Jan.-Oct. 1954
Imports:		
In ore, etc.	120,889	**98,032**
Blister (content)	273,610	**205,664**
Refined copper	274,777	**192,804**
	669,276	**496,500**
Exports:		
In ore, etc.	495	**2,120**
Refined copper	109,510	**186,824**
	110,005	**188,824**
Net imports	559,271	**307,676**

Because of the continuing need for foreign copper for the U. S. market, Congress passed legislation that extended the suspension of the 2c per pound import tax for another year. President Eisenhower on June 30, 1954 signed the bill that extended the period of the suspension of the tax to June 30, 1955. The measure contains price safeguards similar to those contained in previous legislation, namely that the tax would be restored automatically should the average price for a calendar month drop to 24c.

Proposals sponsored by President Ibanez of Chile for settlement of his country's copper difficulties got nowhere. The plan to revise the country's tax and foreign exchange systems, along with adopting a marketing program that would give due consideration to the needs of the producers has been under discussion for more than a year.

Chile accumulated a substantial tonnage of copper in 1953 which hung over the market until the State Department on March 25, 1954, announced it had agreed to purchase 100,000 tons for the U. S. stockpile at the market price. To close the Chilean deal, General Services Administration, on May 20, declared it signed a contract with Anaconda for 64,000 tons of copper, and on May 24, entered into an agreement for 36,000 tons with Kennecott. The Chilean metal was purchased on the basis of 30c per pound.

Demand for copper improved as the first quarter ended and by the middle of May various mines that had reduced output began to expand again. Until a series of strikes for higher wages and other benefits hit the industry in mid-August, producers thought that the situation in copper was well in hand. The work stoppages really upset the applecart. The wage demands in general followed the pattern of the steel agreement arrived at earlier in the year. With a tight supply situation in prospect for the final quarter of the year, buyers were in the market for all the copper that they could get. Labor difficulties in Chile added to the shortages. Domestic consumers appealed to the Government for relief. The Office of Defense Mobilization released about 40,000 tons of copper to industry, which was obtained from inventory held for Government use and the diversion of metal from stockpile deliveries. No copper was released from the stockpile.

Copper—U. S. Statistics

Tons	1953	Estimated 1954
Mine output	926,448	**836,000**
Smelter production	1,067,793	**966,484**
Refined production	1,395,003	**1,311,249**
Net imports	559,271	**350,000**
Deliveries to customers	1,443,719	**1,206,692**
Average price per lb., *E&MJ*	28.798	**29.694**

Copper Prices

Monthly *E&MJ* averages for domestic and foreign copper, basis f.o.b. refinery, Atlantic seaboard, in cents per pound, for last year follow:

	1954	
	Domestic	Foreign (a)
January	**29.671**	**28.767**
February	**29.669**	**29.000**
March	**29.686**	**29.168**
April	**29.700**	**29.520**
May	**29.700**	**29.658**
June	**29.700**	**29.603**
July	**29.700**	**29.570**
August	**29.700**	**29.492**
September	**29.700**	**30.066**
October	**29.700**	**31.529**
November	**29.700**	**31.259**
December	**29.700**	**31.036**
Averages	**29.694**	**29.889**

(a) U. S. refinery equivalent.

London Metal Exchange operations were put to a severe test during the year. The market proved to be a narrow affair and subject to wide price movements. Dissatisfaction over using the LME quotations for pricing purposes increased and late in the year suggestions for introducing a measure of price stability for Commonwealth copper were the subject of discussions among producers.

Producers and fabricators of copper became increasingly concerned over the uninformed views of consumers on the future supply outlook. That users of copper have experienced some really tough times in obtaining supplies cannot be denied. Shortages in war times are unavoidable. But fears of permanent shortages entertained in various quarters were held to be groundless. Barring strikes or other calamities, world production should increase steadily.

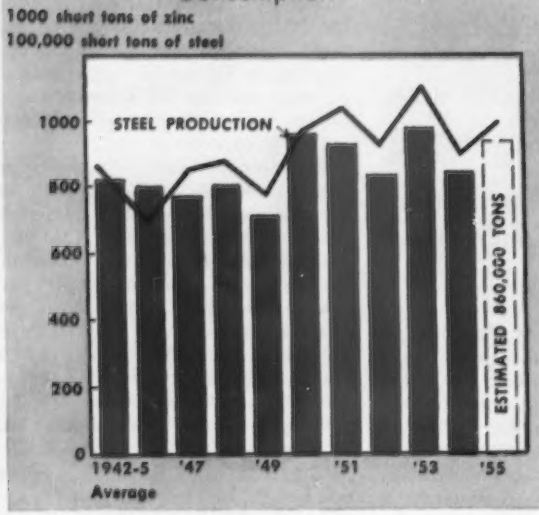
Copper & Brass Research Association launched a campaign in the fall of 1954 directed toward better serving the consumer. Special emphasis was placed on the adequacy of the copper supply. The group assured engineers and designers that copper supplies will keep pace with an expanding market. Increasing competition with aluminum no doubt was a factor in this promotional effort. Copper & Brass Research listed the following new U. S. copper projects, some operating and others scheduled to come into production during 1955 and 1956:

Project	Production tons per year	Start of operation
Copper Cities, Arizona	22,500	Operating
Deep Ruth, Nevada	18,000	1955
Greater Butte Project, Montana	45,000	Operating
Kimberley Pit, Nev.	9,000	Operating
Lavender Pit, Arizona	38,000	Operating
Miami Extension, Arizona	11,500	1955
Osceola Mine, Michigan	7,000	1955
San Manuel, Arizona	70,000	1956
Silver Bell, Arizona	18,000	Operating
White Pine, Michigan	35,000	Early 1955
Yerington, Nevada	33,000	Operating

Outlook for copper for 1955 is for a higher rate of consumption for the world as a whole at fairly stable prices. With costs still rising in all major producing areas, a higher average price for the year would surprise no one. But with production rising, and business prospects for the second half of the year uncertain, capacity output could in time produce a surplus and an easier situation all around●

Slab Zinc in the United States

Consumption



Supply and Demand

In tons	1953	1954*	
SUPPLY			
U.S. primary and secondary production	971,000	865,000	
Imports	227,000	160,000	
	1,198,000	1,025,000	
less exports	18,000	24,000	
less Gov't. account	42,000	110,000	
Available for consumption	1,138,000	891,000	
CONSUMPTION			
Galvanizing	407,000	400,000	(— 1.7%)
Die casting and zinc-base alloys	307,000	275,000	(—10.4%)
Brass products	178,000	102,000	(—42.7%)
Rolled zinc	55,000	46,000	(—16.4%)
Oxide plants and other	39,000	37,000	(— 5.4%)
	986,000	860,000	(—12.8%)
SURPLUS	152,000	31,000	

*Last two months estimated

ZINC

Charles R. Ince
St. Joseph Lead Co.

THE ZINC MARKET in 1954 was one of great extremes. Starting on the rather depressing note of declining demand and increasing surpluses with accompanying weakness in price, the year ended with consumption on the rise, surpluses reduced and a higher and firmer price level.

Consumption of the metal, as usual, patterned itself after the fluctuations in industrial activity. Coincident with the decline in the Federal Reserve Board index in the last half of 1953, zinc consumption started to drop and continued to do so through the first quarter of 1954. As industrial production leveled out, zinc consumption did likewise during the second and third quarters and started to rise early in the fourth quarter. In October, for the first time, zinc consumption exceeded the previous year's monthly figure as did the industrial production index. Despite the year-end improvement, the zinc consumption during 1954 of 860,000 tons was apparently 13% below the previous year's—a greater decline than the 8% recorded by the Federal Reserve Board index of industrial production. This may be attributed to zinc's close affiliation with activity in the steel industry, which was off 21% from 1953. Naturally, such a decline in consumption with the surplus in supply which it engendered could hardly account for the fact that the average price for the year was only a few points below the previous year's—10.68c per lb as against 10.85c. The explanation is—Government stockpiling.

Stockpiling was instituted as a substitute for tariff protection which had been requested by the industry and recommended to the President by the Tariff Commission. Its effect has been to raise the domestic price above the world market and indirectly to strengthen that market. As surpluses developed early in the year the price declined steadily from 10c a lb to 9.25c in February in line with the decline in the world market. With the announcement, first of the intention and subsequently the implementation of Government stockpiling, the market rose rapidly and reached 11.5c in September, where it remained for the balance of the year while the London price moved up during the same period of £83-£84, an advance of £14 or about 1¾c per lb.

At the year's end it was becoming increasingly evident that Government stockpiling was not accomplishing its avowed purpose of "maintaining an adequate mobilization base" in the domestic mining industry. The program has appeared to benefit foreign producers more than domestic miners. Imports of concentrates and metal which had declined to the relatively low level of 42,000 tons per month during the second quarter, rose rapidly with the inception of stockpiling and according to the latest figures available at this writing, were up 15%, close to 50,000 tons a month. This is well in excess of domestic mine production, which has shown little if any change from the second quarter output of less than 40,000 tons per month. This production (about 480,000 tons a year) from domestic mines is far short of the 655,000-ton average for the years 1950 through 1952, which might be considered an adequate mobilization base.

Despite the increase in price, zinc does not appear to be out of line with other commodities and competitive materials as can be seen from the accompanying chart on "Zinc Price in Relation to Other Metals and Wholesale Commodity Price Index." Even with the 1954 rise of 1.5c a lb zinc is only 87% of the Commodity Price Index with lead at 86% and copper and aluminum at 127% and 131%, respectively. The price of the metal certainly was not a factor in the lower consumption of zinc during 1954. The decline was due to the drop in general industrial activity and, in particular, steel operations, but varied to a considerable degree among the zinc-consuming industries.

Galvanizing: For example, the largest use of zinc, that for galvanizing, declined only 2% to around 400,000 tons for the year. Analyzing this use of zinc it is apparent that sheet and strip galvanizing accounted for the relatively good showing which in turn can be attributed to the expansion in continuous galvanizing lines and marketability of their product. At the end of the year 22 of these lines were in operation, 5 under construction and 9 under discussion, 20% more than the year before. The ductility and tightness as well as uniformity of the zinc coating applied by this method has evidently opened up fields of application for zinc-coated sheet never before possible. The continuous galvanizing process has posed problems of grade of metal which zinc smelters will have to adapt themselves to, but over a period of time it cannot but help the zinc industry retain and even enlarge the major outlet for its production.

Die casting and zinc-base alloys still continued to be the second largest consumers of zinc. The consumption of 275,000 tons represented a decline of 10% from the previous year. The decline was not a reflection on the competitive position of the metal nor the die casting process as "the shortest distance between raw material and finished product." The automotive and appliance industries, which are the major outlets for die castings, were off to a more than comparable extent. The increased availability of nickel for plating of castings and the retention of zinc's competitive position pricewise as well as the inherent properties of zinc-base alloys, augurs well for the future use of zinc for this important application.

With automotive production, which accounts for 60% of the use of zinc die castings, estimated at 10% above last year's level and more zinc per unit being used on the new car models due to availability, price, and nickel for plating, it looks as if 1955 consumption of zinc for die castings will exceed all previous levels.

The brass industry, normally accounting for close to 20% of zinc usage, was a major factor in the drop in overall zinc consumption in 1954. As a result of heavy cancellations of military contracts early in the year and subsequent shortages of copper due to strikes, the brass industry's use of zinc declined over 40% to 102,000 tons and accounted for only 12% of consumption.

Rolled zinc, an important but minor use of the metal, was off 16% to 46,000 tons, about in line with the general drop in zinc usage. The direct use of metal for zinc oxide (French process) amounting to 18,500 tons, was off about 13%. It should be pointed out that in addition to the slab zinc used for this purpose, approximately 95,000 tons of zinc in the form of ore and other zinc-bearing materials was used for the direct production of zinc oxide (American process). This latter was a sharp decline, around 35%, from the previous year's figures and reflected reduction in producers' zinc oxide stocks as well as the strikes in the rubber industry and liquidation of tire stocks, which account for roughly half of zinc oxide consumption.

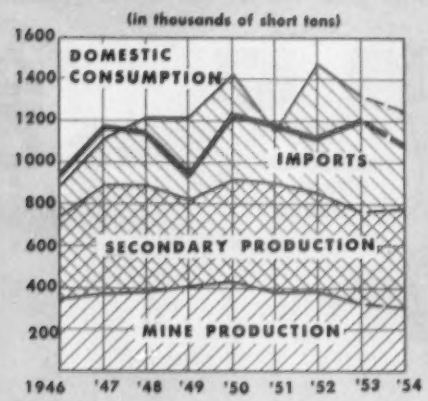
Supply: On the supply side of the picture, domestic smelters including secondary production, turned out approximately 865,000 tons, a reduction of 11% from the previous year's 971,000 tons. Mounting stocks at smelters which discouraged production prior to the Government's stockpiling program, and a strike during the third quarter in the plants of the largest refiner of zinc accounted for the lower rate. However, at the year's end domestic smelters were producing more than 80,000 tons a month—or in excess of a 960,000 ton a year rate. It should be noted that domestic smelter production during 1954 in itself would have been sufficient to take care of domestic requirements and any metal imports whatsoever would have been superfluous.

Imports amounted to around 160,000 tons and their absorption by the market was made possible by Government stockpiling of domestically produced metal. There appears to be no diminution in sight of either metal or ore imports. While demand abroad has improved, a London market price at the current level of £80 plus (10c per lb) looks very attractive to foreign producers and they are stepping up production. A continued high rate of domestic smelter production plus rising imports is obviously going to aggravate the surplus problem unless there is a pickup in domestic consumption to alleviate the situation next year.

Outlook: Such an increase is in prospect for 1955. As a basis for this prediction, one might again refer to the relation of zinc consumption to steel activity as well as the expected increase in the automotive industry, the second largest user of zinc. Steel operations, which have averaged 71% of capacity during the past year, are estimated by authorities at 80% for 1955—an increase of 13%. Automotive production, which ran about 5.4-million units this year is estimated by Harlow Curtice, head of General Motors, at 5.8-million for 1955—this means a prospective increase of around 8%.

Based on these two factors it would appear that an expectation of an improvement in zinc consumption of approximately 10% would not be unreasonable. On this basis, zinc consumption should be around 945,000 tons in 1955, an increase of 85,000 tons. This is good consumption by normal standards and if achieved will have been exceeded in the past only by the 1950 and 1953 rates. With this prospect and the fact that the Government is prepared to stockpile the surplus up to a level of 13c per lb, it is difficult to see how the price of zinc can decline and could even advance as the improved consumption materializes•

Lead—Supply and Demand in The United States



In short tons

SUPPLY	1953	Estimated 1954
Domestic ores	342,000	315,000
Foreign ore and base bullion	162,000	170,000
Secondary	486,000	465,000
Imports of metal	385,000	300,000
Total supplies	1,375,000	1,250,000
DEMAND		
Industrial consumption	1,202,000	1,100,000
Increase in consumers' stocks	—10,500	10,000
Total industrial demand	1,191,500	1,110,000
Excess of supply over demand	183,500	140,000
Increase in stocks at primary smelters and refineries	46,600	10,000
For stockpile and unaccounted for	136,900	130,000

[1]American Bureau of Metal Statistics and U. S. Bureau of Mines.

LEAD

Robert L. Ziegfeld, Secretary
Lead Industries Association

Both consumption and available supply of lead in the United States were off in 1954 from the preceding year by roughly the same amount, with supply again exceeding industrial consumption by well over 100,000 tons. However, resumption of Government stockpiling around the middle of the year and improved demand abroad removed the surplus from the market with a resultant strengthening of the price.

Consumption of lead in the United States was down about 8% from the near record 1953 figure, more or less in line with the contraction in general business, but was still a respectable 1,100,000 tons. At the same time domestic mine production contracted further to the lowest level in 20 yr, secondary production was only slightly off, but imports were down about 15%. In this connection it is interesting to note that imports of ore and concentrates actually increased, an indication of increased foreign production in newer areas without adequate smelting and refining facilities. The further contraction of mine production undoubtedly resulted from the low price prevailing early in the year, and the lower imports probably resulted from improved demand abroad.

The lead market opened the year at 13.50c and subsequent price changes are shown on the accompanying chart.

General improvement throughout most of the year was, in the main, the result of two things. Demand abroad improved and attracted some of the large tonnages of foreign lead which entered the domestic market in 1952 and 1953 as heavy imports. The Government resumed stockpiling in July, taking around 10,000 tons a month of domestic lead off the market for the balance of the year. Actually the Government announced its stockpile program in March and the mere announcement started the upward trend of the market on March 9. The market suffered a temporary set-back in June when the Government asked for offers of lead for stockpile when the market was quoted at 14.25c, but failed to buy at that price. Subsequent announcement that it would buy at the market again strengthened the price.

Tariff: Late in 1953 the U. S. Tariff Commission held hearings on the lead and zinc tariff rates, both as a result of resolutions adopted earlier by the House Ways and Means Committee and Senate Finance Committee, and an appeal under the escape clause of the Trade Agreements Act by the National Lead and Zinc Committee. Its report to the President, made on May 21, 1954, recommended that the full tariff increases permissible by law be granted. However, the President refused the increase on the recommendation of the State Department, pointing to the increased stockpiling program as an alternative aid to the domestic mining industry. The President promised, however, that if stockpiling did not prove adequate, other means of helping the domestic industry would be reviewed. He also appointed a cabinet level committee, headed by the Secretary of the Interior, to review the country's mineral policies and establish a mineral program, which reported late in the year. Since it covers broad mineral policies, the report is beyond the scope of this article.

Supply situation in 1954 was much as might have been expected. The lower prices prevailing during the last two years took their toll of production. Consumption also performed as expected since in general it followed business conditions slightly downward. However, the pattern of consumption was not entirely uniform. Two of the largest consumers, storage batteries and cable, were disappointing in that their consumption was off more than the average. On the other hand, another of the largest users, tetraethyl lead, continued its steady increase. Some smaller uses, like white lead and calking lead, also increased slightly, and type metal held steady.

Outlook: The industry looks toward 1955 with somewhat mixed emotions. What Government stockpiling plans will be after June, the end of the fiscal year, remain to be seen. As for industrial consumption itself, assuming

Use of Lead in the U.S.[a]

(In Short Tons)	1953	Estimated 1954
White lead	17,800	20,000
Red lead and Litharge[b]	88,600	78,000
Storage batteries	367,600	330,000
Cable	146,600	125,000
Building[c]	59,100	52,000
Tetraethyl	162,400	168,000
Ammunition	45,100	39,000
Foil	4,400	4,000
Bearing metal	38,600	27,000
Solder	78,700	72,000
Typemetal	26,700	27,000
Calking	48,200	50,000
Other uses	118,200	108,000
	1,202,000	1,100,000

[a]Based on U.S. Bureau of Mines Statistics.
[b]Exclusive of oxides for storage batteries.
[c]Chiefly pipe, sheet and extrusions. Includes lead used in chemical construction.

Pig Lead Price Changes

1953	Cents per lb., New York[a]	1954	Cents per lb., New York[a]
Jan. 1	14.75	Jan. 18	13.00
7	14.50	Feb. 18	12.50
12	14.00	Mar. 9	12.75
Feb. 2	13.50	10	13.00
Apr. 7	13.25	26	13.25
8	13.00	29	13.50
15	12.50	Apr. 2	13.75
20	12.00	12	14.00
29	12.50	June 2	14.25
May 18	12.75	15	14.00
19	13.00	Aug. 25	14.25
26	13.25	Sept. 7	14.50
June 11	13.50	15	14.75
July 20	13.75	Oct. 6	15.00
23	14.00		
Sept. 16	13.50		

[a]Engineering & Mining Journal

Lead — Average Monthly New York Price

Cents per pound

	1950	1951	1952	1953	1954
January	12.000	17.000	19.000	14.192	13.260
February	12.000	17.000	19.000	13.500	12.818
March	10.963	17.000	19.000	13.404	12.935
April	10.630	17.000	18.923	12.683	13.904
May	11.721	17.000	15.731	12.750	14.000
June	11.808	17.000	15.257	13.413	14.106
July	11.660	17.000	16.000	13.683	14.000
August	12.926	17.000	16.000	14.000	14.058
September	15.800	17.000	16.000	13.740	14.598
October	16.040	19.000	14.404	13.500	14.965
November	17.000	19.000	14.159	13.500	15.000
December	17.000	19.000	14.125	13.500	15.000

that general business will maintain a level equal to or above 1954, it should be at a relatively high rate. At the annual meeting of the Association of American Battery Manufacturers Inc., in November 1954, a forecast was made for an increase in the use of lead of 11% by that industry. This would bring it back to the 1953 level. Since this is the largest use of lead, it is important. Tetraethyl lead is expected to maintain its steady growth with the continued trend towards still higher compression engines. The cable outlook is foggier. Lead continues to meet strong competition from aluminum and plastics and General Cable Corp. announced during the year that it had ordered a press from Germany for direct extrusion of aluminum cable sheath, an indication of still greater competition although such sheath undoubtedly has disadvantages as well as advantages. Since building activity is again expected to be high, calking lead, paints, pipe and other lead products going to this industry should give good accounts of themselves.

In the field of nuclear activity there are no consumption figures available as such, but the growing use of atomic energy and radio isotopes indicates that, while sizeable amounts of lead are already used for protective shielding, shipping containers and other purposes, this use will continue to grow in an important way.

Another interesting development mentioned in my review last year is the marketing of high lead content porcelain enamels for aluminum. This is now being pushed to the trade by Du Pont and some others and the product is being used for some interior partitions and bulkheads on the new carrier "Forrestal" and for exterior walls on several buildings. While there may be no connection, the ceramic industry, which includes porcelain enamels, was one of the few industries which used appreciably more lead in 1954 than in 1953, based on unofficial figures.

On the production side, the higher prices prevailing at the year-end may tend to encourage production somewhat. For example, United Park City Mines resumed production late in the year after the properties had been shut down for several years. Also, there are a number of new areas, particularly outside this country, that are increasing production, as indicated by higher imports of ore and concentrates, or will be important producers in the future. The large deposits of New Brunswick and the Great Slave Lake area of Canada are examples.

All in all, the world's reserves of lead have probably increased substantially in the last few years and appear to be more than adequate to meet the world's needs. Yet the versatility of the metal is a challenge to the industry to find new uses or new applications for old ones.

In the five years ending with 1929, average per capita consumption of lead was 15.1 lb. In the five years ending with 1953, years of high industrial activity also, the average per capita consumption was 14.2 lb. If current per capita consumption could be brought back to the 1925-1929 level, an additional 80,000 tons of lead per year would be used. This would greatly simplify the problems of the lead miner, yet reserves are certainly sufficient to see that the consumer would get the lead he needs at a fair price•

URANIUM

Robert D. Nininger
U. S. Atomic Energy Commission

PRIVATE ACTIVITY IN URANIUM exploration and production reached an all-time high in 1954, the seventh year of the Atomic Energy Commission's program of guaranteed prices, bonuses, and extensive Government exploration. The uranium industry has, in less than a decade, reached the beginnings of maturity and a stage of development approaching that of the major metal industries which have been active in this country for more than a century.

Important new discoveries and developments of 1952 and 1953 were proven in 1954 to be only the beginning of a normal pattern for the industry rather than isolated examples of prospecting luck. As a result, those major mining companies not already in the uranium business joined Anaconda, Climax, Homestake, U. S. Vanadium, Vanadium Corp., and a host of other companies large and small, at least to the extent of looking into it. At the same time nearly all of the important oil companies and numerous large combines and syndicates began to enter the field. It has become evident that the uranium industry provides the opportunity for big capital to engage in large-scale exploration and production programs with reasonable assurance of substantial profits.

An unprecedented number of significant developments were chalked up in 1954.

1. Sources which produced little or no uranium in 1948, the United States, South Africa, and the Beaverlodge area, Canada, supplied much of the world's production.

2. U. S. was in the race for top place among the world's uranium producers. Uranium ore production in the Colorado Plateau and adjacent areas greatly exceeded 1953 production.

3. Australia became a uranium producer.

4. Ore reserves in the U. S. as tabulated by the Atomic Energy Commission more than doubled during the year.

5. Largest property transfer to date was concluded between Atlas Corporation and Vernon Pick, owner of the Delta Mine in Utah, for a reported $9-million.

6. Largest private financing ($19,500,000) for a single uranium operation (Gunnar Mines) was completed.

7. First uranium ore shipments were made from California, Nevada and Washington.

8. Sale of uranium stocks became for the first time a major activity in Salt Lake City, San Francisco and New York, and the first SEC "crackdown" occurred.

9. Prospecting fever spread to east coast states from Maine to Georgia, and from the North American continent to Australia, where the uranium boom in Queensland and in the Northern Territory vied for top attention with the oil boom.

10. Deposits of black primary minerals, similar to the new-type black ore deposits of the Colorado Plateau, were found in the Wind River, Wyo., and Edgemont, S. D., districts.

11. Design was begun on the first new mill in the U. S. to exceed an initial capacity of 500 tons, and the first mills in Canada to exceed 1,000 tons.

12. The uranium industry in the U. S. reached an estimated annual rate of expenditure of $100-million or more.

13. Off-the-shelf procurement of high quality radiation detection equipment satisfactory for drill-hole logging and aerial surveying became possible for the first time.

14. Talk of uranium and atomic energy for peacetime uses, particularly atomic power, exceeded discussion of requirements for weapons and defense.

15. The AEC made public the first clue to production rates and prices for uranium concentrates: On the basis of AEC studies, Jesse C. Johnson, director of the AEC's Division of Raw Materals, stated that uranium requirements for nuclear power by 1975 or 1980 might be on the order of 17,000 tons of U_3O_8 annually which he felt on the basis of our knowledge of Free World uranium resources should be available at a price of not more than $10 per lb in high-grade concentrates.

Domestic Developments

Uranium exploration, mining and processing occupied a major place in the non-ferrous metal mining industry in 1954 from a dollar standpoint. There were more than 900 producing mines as compared to slightly more than 600 in 1953. Ore production increased accordingly, and three new States (California, Washington, and Nevada) were added to the list of uranium producers, making a total of eleven.

Government exploration program continued at about the same level as in 1953, but private activity increased several times. Private drilling, primarily on the Colorado Plateau, was estimated at 2- to 3-million ft contrasted to about 1-million feet of Government drilling by the AEC, USGS, and USBM.

For the first time intensive exploration spread from the Plateau to outlying areas; an estimated 500,000 ft of private and Government drilling was carried out in Wyoming and South Dakota. By the end of 1954, DMEA had granted approximately 70 uranium exploration loans, totaling more than $1½-million. The total number of 100,000 ton orebodies reached about 20, of which several were approaching or had already exceeded reserves of 500,000 tons. Anaconda's Jackpile mine, east of Grants, N. M., reached the several-million-ton class.

Milling also progressed apace toward narrowing the gap between ore discovery and ore processing rates. One new mill at Shiprock, N. M., was completed by Kerr-McGee Oil Industries, and all but one of the other eight mills on the Colorado Plateau completed or were in the process of expanding. Anaconda began a third expansion of its milling facilities at Bluewater, N. M. Plans for a large new mill at Moab, Utah, to treat ore from Steen's and other properties in Big Indian Wash were nearing completion. An eleventh mill, the first off the Plateau, to process ores from the Black Hills and eastern Wyoming was under consideration, and new ore buying stations at Riverton, Wyo., and White Canyon, Utah, presaged the possibility of even additional milling facilities in the future.

No longer were mill men talking the old figures of 100 or 200 tpd capacity. This had been upped in the major producing districts to 500 to 1,000 tons per day.

New geologic developments vied with the tremendous increase in private exploration activity in 1954 in a chicken and egg relationship. Primary ores on the Colorado Plateau are no longer geologic curiosities, but accepted by most mining men as one of

the basic Plateau types. Uraninite is no longer considered solely a vein mineral; perhaps half of the ore bodies in the 100,000-ton class on the Plateau comprise largely primary minerals and many of the others contain significant amounts of those minerals. The historic carnotite-type deposits of the Plateau are now believed by many geologists to be merely oxidized remnants of deposits of primary minerals.

As prospecting activity, new discoveries, and production expanded outward from the Plateau, the Plateau experience was repeated, but telescoped in time. Black primary ore in substantial quantities was discovered in the Edgemont, S. D., district in 1954, three years after the original discovery, and in the Gas Hills district, Wyo., one year after the first secondary mineral discovery in 1953.

Developments on the Colorado Plateau and in Wyoming and South Dakota also continued to broaden the stratigraphic range favorable for uranium. Mineralization has now been found in more than 40 sedimentary units and ore has been produced from approximately 30. These range in age from Cambrian to recent and include every geologic period between Pennsylvanian and Pliocene, inclusive.

Tertiary formations, which have been the most favored in central and southern Wyoming, revealed new deposits in late 1954 in North and South Dakota, Nebraska, Nevada, and California. Arkosic, tuffaceous, phosphatic, and calcareous sandstones, and lignites, are all favored. Discovery of ore in the lignites of North and South Dakota, previously thought to contain only traces of uranium, and in the basin sediments of Nevada and California, are the most recent developments and open up new horizons.

Several hundred tons of high-grade lignitic material has already been shipped to the Edgemont, S. D., buying station although the treatment process has not yet been worked out.

Foreign Developments

South Africa became a major producer with eight plants in operation at the end of 1954, and others scheduled to turn over in 1955. The total cost of presently planned plants will exceed $180,000,000.

Canadian production substantially increased with the first full year's operation of the Eldorado plant at Beaverlodge, Saskatchewan. A 1250-tpd mill for the Gunnar Mines deposit near Beaverlodge and a plant of 1,000 tons or more for the Blind River, Ont., deposits to be constructed in 1955 will push Canada further to the front in production. Other plants to treat ores from the Blind River area are in the planning stage.

Australia promised to become an important producer with the opening of the Rum Jungle mill in September and the Radium Hill concentrating plant shortly afterward. The Port Pirie plant to treat Radium Hill concentrates is scheduled to turn over early in 1955. Portugal and France continued to produce with some expansion of the latter. Small production of ore or concentrates in Argentina, Madagascar, Mozambique and Sweden completed the uranium production picture in the Free World.

Latin America leads the so-far unproductive areas of the Free World in prospecting activity. The Junta de Control de Sustancias Radioactivas of Peru announced price schedules roughly equivalent to U. S. prices for uranium ores of 0.5% U_3O_8 content or better. A Comisíon de Minerales Radioactivos was established in Bolivia as part of a program to encourage prospecting for and development of uranium deposits, and newly discovered occurrences were reported in Peru, Bolivia, Chile and Brazil.

Geophysics

Prospecting instrumentation progressed rapidly during 1954. For the first time adequate counters for airborne and drill-hole use were available from a variety of manufacturers on short delivery schedules. In addition to ten light aircraft operated by the AEC and two DC-3's operated by the USGS in aerial radiometric surveying, approximately 75 private aircraft were in operation during the year.

Both Government and private operations made extensive use of drill-hole logging equipment, both truck-mounted and portable, in connection with drilling programs, and petroleum companies began radiometric logging of a significant proportion of seismic shot holes drilled in petroleum exploration. At least one new company was established to furnish uranium drill-hole logging service by contract.

Other geophysical techniques were also beginning to be used. Both the Government and geophysical service companies have carried out combination gamma-electric logging; seismic refraction and resistivity techniques have been used on some Government drilling projects.

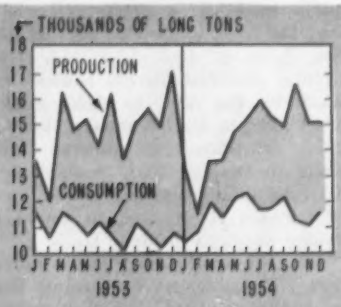
Legislation

In August, the President signed Public Law 585 amending the mineral laws to provide for multiple mineral development of the same tracts of the public lands. As a result of the new law, the AEC terminated its Circular No. 7, as of Dec. 12, 1954. This circular provided for the issuance of leases by the AEC to make public lands affected by the mineral leasing laws, and closed to mineral entry under the mining laws, available for uranium mining purposes. Public Law 585 makes it possible to establish mining locations on these lands.

The President also signed Public Law 703, known as the Atomic Energy Act of 1954, the first major revision of the original Atomic Energy Act of 1946 pursuant to which the Commission was established. Most of the important new provisions of this Act, which were concerned with private development of nuclear power and international cooperation, did not directly affect the uranium mining industry. However, the Act did repeal the provisions of the 1946 Act reserving uranium on public lands to the U. S. Since the Government had permitted staking of uranium claims on public lands, and mining and selling of the uranium ore found, under the old law, the repeal of the reservation had no practical effect. It did, however, eliminate an ambiguity by placing uranium exploration and mining on the public lands in the hands of private enterprise.

The outlook for 1955 is one of continued expansion of the uranium mining industry, although perhaps in a slightly less hectic manner. Next year might be considered a "shake-down" period which should see elimination of many of the myriad small or unsound uranium promotions in the west through consolidations, purchase by larger companies, or failure. Sound enterprises will consolidate their positions and expand their activities. Some of the larger companies among those new in the industry may be expected to embark upon extensive exploration programs after they have established profitable mining and milling operations on recently acquired properties.

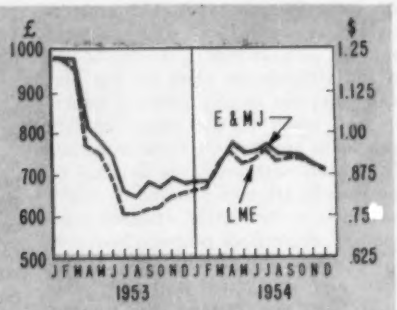
Uranium requirements to feed expanded facilities for the production of nuclear materials authorized by Congress in 1952 to meet defense needs continue to rise. Long range industrial requirements, that is 20-30 years hence, should be large and may eventually more than take up the slack should defense requirements fall off. It has been estimated that 17,000 tons of U_3O_8 may be an annual requirement for industrial uses by 1975 or 1980. Experience has also taught us that estimates of this type made 20 years in advance are almost always short of the mark•



World production of tin-in-concentrates.
World consumption of primary tin.
Data from Tin Study Group in thousands of long tons.

Primary Tin Statistics

Long tons	1953	1954
World mine output	178,000	174,000
World consumption	130,000	138,000
World stocks:		
Govt's included	314,000	350,000
Govt's excluded	98,000	75,000
U. S. consumption	54,000	57,000
U. S. imports (pig)	75,000	63,000
U. S. output (pig)		
Texas City smelter	38,000	27,000
Average price, N. Y., prompt	95.845c	91.838c
Average price LME, cash	£731.7	£719.5



The LME price is in £ per long ton; the E&MJ price is dollars per pound. The scales are equivalent at an exchange rate of $2.80=£1. £800 for a long ton=$1.00 per pound.

TIN

George H. Cleaver
Associate Market Editor

IN 1954 it became more obvious that output of tin was in excess of consumption and that if the expected stoppage or curtailment of U.S. stockpiling occurs, the producing industry might be hard hit.

Most of the surplus, perhaps all of it, has been going into the U.S. stockpile. Late in 1953 a U.S. delegate to the U.N. International Tin Conference said that by March 1954 the U.S. would have about 40,000 tons of tin in excess of stockpile needs.

If the political situation results in continued operation of the Texas City tin smelter with its some 2,400 tons a month output, and if this leads to continuation of U.S. stockpiling, the tin producing industry probably will be able to avoid some of the troubles it now faces. Production ceased at the smelter during part of the summer but Congress passed a resolution to keep it operating through June 30, 1955; the resolution also provided for stockpiling the tin. President Eisenhower's fiscal message to Congress, January 1955, makes no provision for the Texas City smelter for the coming fiscal year; he also left it out last year.

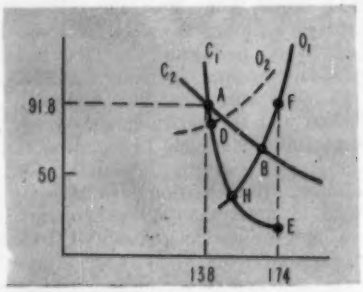
The urgency, from the producer point of view, of the International Tin Agreement is based on the above circumstance. If no agreement is in operation, enough of the excess output (assuming stockpiling drops) may hit the market to drive the price well below the 80c minimum envisioned in the proposed agreement.

No one doubts there will be a tin agreement; some question if any agreement will work. There is still some doubt that the one proposed will obtain sufficient votes. The main question now—will enough consumers come in? The producers can institute one among themselves, and there is widespread belief that producers will dominate any "agreement." But the delay involved in acceptance, and the further delay if a strictly producer pact is negotiated, may find the price extremely low.

Tin consumption is inelastic (though over a period of years it might shift up or down); it won't vary much with changes in price.

In 1954 industry consumed about 138,000 tons; output of tin in concentrates was about 174,000 tons. At what price would consumers use 174,000 tons? They wouldn't, or if they did it might be as indicated in our chart by E on the "consumers reaction curve" C_1—at a price so low that few producers could cover costs. Few think that consumption of tin will become elastic, as in the curve C_2. Some think that the rapid expansion of soft drinks in cans may in future years shift C_1 farther to the right. The amount of tin consumed per unit of tinplate may have reached its minimum, in which case future expansion of tinplate will be reflected in increased tin consumption. Neither of these has much significance for the next couple of years.

Most agree production will need to drop. With reduced stockpiling there would be price adjustments and higher cost production would drop out. In the chart, price and output would be indicated by a point within ABH; our guess is that it would be closer to H than to A. A represents the 1954 tin price and industrial consumption; F represents price and production.



Consumption and output in thousands of long tons are indicated horizontally. Price per lb vertically. C_1 and C_2 are consumer reaction curves. O_1 and O_2 are producer reaction curves. O_2 represents controlled output, O_1 "free" competition.

The essential purpose in a tin agreement is to control changes in output in relation to changes in purchases. A "free" market producers reaction curve may be indicated by O_1. The significance of a tin agreement is shown by a controlled producers reaction curve O_2. A precariously low price may be avoided—price D rather than H. There are other implications of this which will be obvious from the chart. The problem in part is one of the speed in which "mine" and smelter output is reduced following, or in anticipation of, unfavorable market developments. The proposed buffer stock for a period could take up some of the surplus, as could consumer inventory expansion, but in the longer run these are not answers to overproduction. The controlled supply, as indicated by the curve O_2, is an answer.

The International Tin Agreement provides a buffer stock of 10,000-25,000 long tons, a tentative price range of $.80-$1.10 with buffer stock selling at $1.00 or above and buying at $.90 or below. To Jan. 20, 1955, of 333 consumer votes needed (1,000 possible) 208 were in; of 900 needed producer votes (1,000 possible) 631 were in•

MERCURY

Helena M. Meyer
U. S. Bureau of Mines

PRICE OF MERCURY trended upward from the second week in November 1953 through October 1954 to establish new all-time weekly, monthly, and annual peaks. Upsurge in prices was occasioned by the shortage of mercury for sale in quantity lots during most of the year, despite the fact that imports during the first three quarters of the year almost equaled the near-record rate attained in 1953 and that domestic production rose for the fourth successive year, while industrial consumption and exports declined. U. S. Government purchases were a factor.

Price: In 1953 supplies exceeded requirements, and the price dropped to a monthly average of $183.42 in October, the lowest monthly average since December 1950. The price strengthened a little during the final weeks of 1953 and ranged from $187 to $189 when 1954 opened. Every price change in 1954 until November was upward, and throughout October the price stood at an unprecedented $325-$330; it weakened in the final weeks of the year and was $318-$320 on Dec. 8.

Government took several steps towards strengthening the current and future supply situation in the U. S. Mercury, which had been removed from the list of strategic commodities entitled to receive DMEA loans, was reinstated in March 1954. Effective June 5 the Bureau of Foreign Commerce required export licenses for mercury to all destinations except Canada. In July the General Services Administration announced a 3-yr guaranteed-price program for mercury. The announcement stated that it was designed to "broaden the mobilization base of the metal and increase its supply for defense and industrial purposes." The program called for buying (at $225 a flask) a maximum of 125,000 flasks of domestic mercury and 75,000 flasks of Mexican metal but was scheduled to end on Dec. 31, 1957, even if such quantities had not been obtained. The $225 price for Mexican metal includes the tariff of $19. The program provided also for possible contracts with foreign producers, particularly those in Canada. No mercury was currently being produced in Canada, so any such contracts would involve reopening closed or opening new mines. Under the Internal Revenue Code of 1954 the percentage depletion for mercury, among other minerals, was raised to 23% from 15%.

Mercury

Flasks of 76 lb	1953	1954
Production	14,337	[1]19,400
Imports (general)	85,784	[2]61,400
Exports	546	[2]855
Average price, New York	$193.03	[1]$264.50

[1]Estimated. [2] 9 months.

Imports were 61,000 flasks January-September, compared with 86,000 flasks in all of 1953, second only to the all-time 1949 record. Spain supplied 47% of the quantity entered in January-September 1954, while Italy furnished 35%, Mexico 12%, Yugoslavia 6%. In 1953 44% came from Italy, 33% from Spain, 16% from Mexico, and 7% from Yugoslavia.

Domestic production in 1954 continued the uptrend already in progress and rose during each quarter of the year; output in the final quarter was at the highest 3-month rate since the first quarter of 1948. Production for the year, nonetheless, approximated only 20% of imports. Of the total U. S. output California supplied 60 to 65%, Nevada 25%, Alaska 5%, and Idaho and Oregon each somewhat less; a small quantity came from Arizona. Leading producers were:

Alaska.....Red Devil
California;
Lake County.....Abbott
San Benito County..New Idria (including San Carlos)
San Luis Obispo County.....La Libertad
Sonoma County....Buckman (including Cloverdale and Culver-Baer)
Mount Jackson (including Great Eastern)
Idaho;
Valley County.....Hermes
Nevada;
Humboldt County..Cordero
Oregon;
Douglas County...Bonanza

The output of these nine properties was nearly 95% of the U. S. total.

Operators of mercury properties were recipients of DMEA loans, as in 1953, and reserves of mercury-bearing ores were increased under the program. Repayments were made to the Government in 1954 for production from ore developed with DMEA assistance.

If industrial consumption in the final quarter continued at the January-September rate, the total for the year was 19% below that in 1953. Three new chlorine and caustic soda installations using mercury cells were put into production in 1953 and capacity at another such plant was expanded. No such installations were made in 1954, which largely explains the drop in consumption.

Exports of mercury declined from a quarterly average of 350 flasks in the first 6 months to 84 in the third quarter; re-exports were 640 and 85 flasks, respectively.

Industrial stocks dropped 4,000 flasks—from 27,000 flasks on Jan. 1 to 23,000 on Sept. 30. These totals include a large quantity of metal tied up in a new chlorine and caustic soda installation that will use mercury cells when put into operation. Stocks, therefore, were well below the quantities normally held by the industry. Inventories do not cover the large quantities held by the Government.

Action of the United Kingdom and Canadian Governments in restricting exports of mercury attested to an inadequate supply situation outside the U. S. Canadian restrictions do not apply to U. S. shipments.

Outlook: World production has been trending upward and should make further gains if recent peak prices continue or even if prices drop moderately. U. S. and Mexican producers, contrary to the usual world relationship, currently have at least a partly superior position because of the GSA guaranteed-price program, which protects them against a price below $225 a flask. Production in the U. S. and Mexico probably will expand substantially in the next year and maintain an uptrend for some time longer. The GSA program doubtless will run to the end of 1957, because it is unlikely that even expanded U. S. and Mexican production can supply the maximum quantities specified in the program between the time, if it comes, that the guaranteed price exceeds the market price and the end of 1957. Continued market conditions, meanwhile, tend to curtail consumption of mercury for some purposes and to discourage development of new uses •

FERROALLOYS

Norwood B. Melcher
U. S. Bureau of Mines

ALL GROUPS of ferroalloying metals showed substantial drops in production and shipments in 1954 as compared with the previous year.

Raw materials for ferroalloy production dropped in price as a result of reduced buying rates by both industry and Government. Smaller Government purchases reflected approaching completion of stockpile objectives in a number of strategic materials. Examples of lower prices are found in manganese, which dropped from $1.10 per long-ton unit (Indian, 46 to 48% Mn) early in January, to less than $0.75 in September, and in metallurgical chromite (Turkish), which dropped from $54 per long ton to $46 in the same period. By the year end, there was evidence of a strengthening in the market for manganese ore and chromite, and prices for both rose.

Nickel was an exception.

Outlook for ferroalloys in the first quarter of 1955 is for a continued increase in consumer requirements, with steel continuing to be the most important factor governing the level of demand. Stockpiling acquisitions will continue at a high rate throughout 1955. Lower grade ferroalloys will increase in usage because of lower price and gradual depletion of high-grade ores. High-purity metals will find many new uses as research develops new and improved production methods•

COBALT

Hubert W. Davis
U. S. Bureau of Mines

PROGRESS IN RECENT YEARS in metallurgical research for extractive methods for cobalt has resulted in a substantial increase in world production, which now greatly exceeds civilian needs.

Free World production is estimated at 14,500 short tons in 1954 compared with 13,500 tons in 1953.

Imports of cobalt into the United States in the first 10 months of 1954 established a new record and were 4% greater than during the corresponding period of 1953. Noteworthy were the initial receipt of cobalt metal from Northern Rhodesia, greatly increased supplies of metal from Canada, Norway, and West Germany, and the importation of 263,000 lb of cobalt sulphate from West Germany during the first 10 months of 1954. Despite improved supply position, consumption in the U. S. was 35% less than in 1953 and the smallest since 1949, chiefly because of a large decline in use of cobalt in high-temperature alloys and a substantial drop in usage in permanent-magnet alloys and cemented carbides.

U. S. Supply. Production of cobalt metal for 10 months was 6% more than in the corresponding period 1953. Imports gained 10%. Production of oxide was down 28%; oxide imports, down 37%. Production (cobalt content) of salts and driers during the first 10 months was 231,070 and 335,460 lb respectively (down 16 and 25%); shipments were 228,303 and 359,393 lb, respectively (down 15 and 18%). Imports of cobalt salts and compounds were 293,500 lb (gross weight) (up 97%). Production of hydrate was 164,879 lb (cobalt content) (up 131%); shipments were 125,292 lb (up 105%).

Consumption was 5,947,000 lb during the first 10 months compared with 9,182,000 lb in the corresponding period of 1953. Cobalt-chromium-tungsten-molybdenum alloys represented 38% of cobalt consumption, but the quantity used was 50% less than in 1953 and the smallest since 1950. Magnet alloys took 28% (down 21%). Less cobalt was also used in high-speed steels, low-cobalt alloy steels, alloy hard-facing rods, cemented carbides, and ground-coat frit but more in pigments.

Among the Producers. Bethlehem Steel Co. and Calera Mining Co. con-

MOLYBDENUM

Robert W. Geehan
U. S. Bureau of Mines

MOLYBDENUM PRODUCTION in the U. S. in 1954, about 90% of the world's total, declined slightly from the previous year. The record 1954 output resulting from the first full year's use of recently completed facilities at the Climax, Colo., molybdenum mine was more than offset by a decline in recovery from by-product sources. Consumption of molybdenite concentrates, reflecting the low output of alloy steel, was less than that in any year since 1949. On the other hand, shipments for export reached all-time highs more than double 1953.

Climax Molybdenum Co.'s mine at Climax, Colo., reached a daily capacity of 27,000 tons of ore early in January, when a 5,000-ton mill unit was placed in operation. Production came from two levels; output of the newly developed Storke level was standard-grade ore, while from the Philipson level, 300 ft higher, both standard and low-grade ore was mined.

Production from by-product sources was less than in 1953 because of curtailed output at several copper mines. Early in 1954 a substantial reduction in demand for copper led to a reduced rate of production; later in the year strikes cut output.

Ferroalloys Produced and Shipped from Furnaces in the U. S., 1953-54

	1953			1954 (Estimate)		
	Production (short tons)	Shipments Short tons	Value	Production (short tons)	Shipments Short tons	Value
Ferromanganese	907,533	900,110	$185,192,588	700,000	675,000	$153,000,000
Spiegeleisen						
Silicomanganese	226,376	192,656	32,855,142	160,000	130,000	
Manganese briquets						
Chromium alloys	284,793	253,636	97,849,597	175,000	180,000	70,000,000
Silicon alloys	808,605	772,697	86,096,619	685,000	630,000	70,000,000
Ferrotungsten						
Ferromolybdenum	23,570	23,167	40,496,355	90,000	80,000	42,000,000
Other molybdenum products						
Other ferroalloys	85,409	66,692	23,706,548			
Total	2,336,286	2,208,958	$466,196,849	1,810,000	1,695,000	$335,000,000

tinued to produce cobalt concentrates from domestic ore. Production (cobalt content) was 1,682,000 lb in the first 10 months compared with 1,012,000 lb in the corresponding period 1953.

The Garfield (Utah) refinery of Calera Mining Co., which began commercial production of cobalt metal in March 1953, operated at only about one fifth of capacity; however, output in the first 10 months was 54% greater than in the corresponding period of 1953. Calera Mining Co. signed a 2-year agreement with Chemical Construction Corp., designer and builder of the plant, to operate the refinery and place it on a commercial basis.

African Metals Corp.'s refinery at Niagara Falls, N. Y., operated at a rate about 4% under 1953 and the refinery of Pyrites Co. at Wilmington, Del., at about 10% less. National Lead Co. was expected to begin commercial production early in 1955 at Fredericktown, Mo. Union Miniére du Haut-Katanga, Belgian Congo, largest producer in the world, operated at near capacity.

As a result of improved efficiency and greater continuity of operation at its new refinery at Nkana, Northern Rhodesia, Rhokana Corp. produced 693 short tons of cobalt metal in the year ended June 30, 1954, compared with 259 tons in 1953. In addition, it produced 571 tons of cobalt in other forms compared with 487 tons in 1953.

International Nickel Co. of Canada, Ltd., began commercial production of electrolytic cobalt at its Port Colborne (Canada) refinery in October.

Forecast. Free World production of cobalt is expected to continue its upward trend in 1955, and because of the improved supply position less emphasis may be placed on conservation; consequently, increased consumption is anticipated.

Cobalt Statistics

Pounds	Metal 1953	Metal 1954 (10 mo.)	Oxide (gross wt.) 1953	Oxide (gross wt.) 1954 (10 mo.)
U. S. Production	2,887,487	2,385,315	579,457	378,952
U. S. Imports	14,431,894	12,392,000	610,054	386,819
Belgium-Belgian Congo	12,906,118	10,259,574	590,800	371,900
Canada	727,373	1,008,490	.....	.....
West Germany	589,818	829,426	2,200	14,919
Norway	208,450	262,141	.....	.....
Price per lb	$2.40-$2.60	$2.60	$1.82-1.96	$1.96

Domestic production of molybdenum in concentrates was 46,984,000 lb during the first 10 months of 1954, contrasted to 47,813,000 for the same period of 1953.

Exports provide an appreciable share of the market for domestic production; this was particularly true in 1954 when they reached record highs at the same time that U.S. consumption was unusually low. United Kingdom, West Germany, France and Sweden received nearly all.

Shipments of primary molybdenum products during the first 10 months of 1954 were at a rate 20% less than those of 1953, largely because of the reduced output of steel.

Price. The first change in prices of molybdenum products since December 1950 by Climax Molybdenum Co. was announced on Dec. 10; the prices per lb of molybdenum content are as follows: Concentrate $1.05 (formerly $1.00), molybdic oxide $1.25 ($1.14), calcium molybdate $1.28 ($1.15), and ferro-molybdenum $1.46 ($1.32).

Canada's production of molybdenite is scheduled for expansion as a result of a contract between Molybdenite Corp. of Canada, Ltd., and the Government; output is from the La-Corne mine in western Quebec. According to the Canadian Government, the company was to increase milling from 280 tons per day to 350 tons.

Molybdenum Concentrates in the U. S.

(Thousands of pounds molybdenum content)

	1953	Estimated 1954
Production	57,243	57,000
Consumption	31,193	24,000
Shipments for export	5,893	12,000

Chromite Prices in 1954

Source	Cr_2O_3, %	Cr:Fe Ratio	Prices per long ton* January	December
Southern Rhodesia	48	3:1**	$44-$46	$43-$44
Southern Rhodesia	48	2.8:1	40-42	40-41
Southern Rhodesia	48	..	32-34	32-33
South Africa (Transvaal)	48	..	33-34	31-32
South Africa (Transvaal)	44	..	23-24	21-22
Turkey	48	3:1**	53-54	46-48
Pakistan	48	3:1**	51-52	43-44
Domestic	48	3:1**	$115	$115

*Foreign quotations are on a dry basis, subject to penalties if guarantees are not met, f.o.b. cars, U. S. east coast ports. Rhodesian prices are on a long-term contract basis. Turkish and Pakistan prices are nominal. Domestic prices are those paid by the Government, delivered, Grants Pass, Ore., dept.
**Lump ore.

CHROMIUM

Charles Katlin
U. S. Bureau of Mines

CHROMITE CONSUMPTION AND IMPORTS and output of chrome products declined substantially in 1954 owing to greatly diminished industrial demand and overly expanded stocks of chrome ore and products. Domestic production of chromite rose, however, because of Government purchases. Prices of some foreign ores dropped, particularly those from Turkey. Turkish chrome production was at very low level, and many shipments were made from stocks accumulated during 1953.

U. S. Production: A full year of production from the Mouat chrome mine in the Stillwater complex of Montana, raised the total output of chromite in the U. S. to over 2½ times that of 1953.

Alaska's first shipment of chromite in 10 yr was made from the Star Four mine on Red Mountain, Kenai Peninsula, by the Kenai Chrome Co.

Consumption of chromium alloys and metal declined about 30% below the previous year's level. The general lack of demand thus indicated, coupled with bulging inventories of both chrome products and ores, reduced the consumption of chromite for all purposes to two thirds of the 1953 level. During the first 9 months of the year, the average chromic oxide content of all ore consumed for metallurgical purposes was 46%, thus maintaining the trend to greater use of lower grade ores in making lower chrome-content ferroalloys. These chrome alloys had an average chrome content about 1½% lower than in 1953 and about 2½% lower than in 1952.

Chromite Statistics in the U. S.
(Thousands of short tons)

	1953	(Est.) 1954
Imports	2,227	1,500
Production (shipments)	58	160
Consumption: (Total)	1,336	906
Metallurgical	743	492
Refractory	441	280
Chemical	152	134

Total imports for 1954 were only about two thirds of the previous year's all-time high. Greatly curtailed industrial demand was a major reason for this decline, but excessive imports during 1953, creating an over-expanded inventory position, contributed in no small measure. Imports continued to exceed demand during the early part of 1954, probably because of contractual obligations.

During the first 9 months, the Republic of the Philippines was by far the principal source of all chrome imports, shipping about a third of the total and 83% of the refractory grade. Over half of all imports was destined for metallurgical use; ore came chiefly from Turkey (37%), Southern Rhodesia (35%), and the Union of South Africa (14%). Chemical ore was received solely from the Union of South Africa.

As a result of poor industrial demand, termination of U. S. Government contracts, and high prices as compared with similar ores from other sources, Turkish chromite production dropped drastically; U. S. imports from Turkey were only about half those of 1953. Only a few of the larger mines were operating, and many contracts were reported to have been canceled. During the latter part of the year, the U. S. Government agreed to purchase 100,000 tons of chromite from Turkey under an old contract and also agreed to barter about 100,000 tons of U. S. surplus wheat for Turkish chromite. The bulk of these tonnages will not be received until 1955. Turkish chromite prices had reportedly dropped $10 in a 12-month period (prices were nominal, as virtually no commercial transactions were completed); but toward the close of the year, the price was apparently on the way up, presumably as a result of the cited transactions. Stocks of mined ore in Turkey were reportedly up to 400,000 tons.

Developments: Apparently reflecting establishment of production efficiency, the price of 99% pure electrolytic chromium metal, produced commercially at the new Marietta, Ohio, plant of the Electro Metallurgical Corp. only, was reduced to the same level as the 97% grade aluminothermic chromium, $1.16 per lb.

Refractory bricks of 60:40 chrome-magnesia ratio made by the U. S. Bureau of Mines from domestic off-grade chromites were found to be highly satisfactory in actual use tests conducted by industry.

Concentrates of Oregon chrome beach sands stockpiled by the Government during World War II were smelted by Pacific Northwest Alloys, Inc., at Mead, Wash., in making a special low-grade low-carbon ferrochromium for Government stockpiling.

A Cuban exploration program was initiated by the U.S. Geological Survey under contract with GSA to block out 800,000 long tons of refractory chromite reserves in the Camaguey district. Exploration costs, which may not exceed one half million dollars, may be repaid in part by the principal owners of property whereon ore is found.

Benguet Consolidated Mining Co., operator of the Masinloc mine in the Zambales Mountains of Luzon, P. I., contracted with the U. S. Government for the sale of 250,000 tons of refractory chromite. A mill expansion program was concluded, increasing washing, hand picking, and heavy-medium separation facilities. It was expected that the railroad from the

mine to the pier would be completed by the year end.

Rhodesian Vanadium Corp. began operation of its flotation plant for concentration of eluvial chrome deposits in Southern Rhodesia, Federation of Rhodesia and Nyasaland.

Outlook: Although industrial activity was rising toward the end of 1954, industrial chromite imports probably will not increase substantially until the large inventories of chrome ores and products are lowered. Government importation of chromite during 1955 will increase if additional agricultural surplus barter transactions are negotiated. U. S. production of chromite is expected to increase slightly above the current level•

Tungsten Ore and Concentrates in the U. S.

(Thousands of pounds, metal content)

	1953	Estimated 1954
Production	9,273	13,100
Consumption	7,734	4,100
General imports	28,994	22,000
Industry stocks, end of period	4,698	4,136*

*Sept. 30, 1954.

TUNGSTEN

Robert W. Geehan
U. S. Bureau of Mines

DOMESTIC OUTPUT OF TUNGSTEN in concentrates reached an all-time high in 1954 and preliminary data indicate that the U. S. was the leading producer of tungsten in the Free World. Production, nearly three times consumption, was higher than in any year since 1945. This record output resulted largely from the stimulation of long-term favorable prices paid by the Government under terms of the Domestic Tungsten Program.

Domestic production in 1954 was obtained from many widely scattered operations in 10 states and Alaska. Leading individual producing mine was the Hamme unit of Tungsten Mining Corp. in North Carolina, where output compared with 1953 increased over 15%; mill capacity was rated at 650 tpd. Leading individual milling unit was the Pine Creek, Calif., mill of United States Vanadium Co., where custom ores and material from the company mine were treated along with low-grade concentrates from other mills; the total concentrate produced at this plant also increased 15%.

At the Pine Creek mine the 1500-ft raise which serves as a shaft connecting two adit levels was completed; this will allow more efficient production, particularly from the upper levels. During 1954 the Ivanhoe mine operated by Minerals Engineering Co. near Glen, Mont., became an important producer of tungsten concentrates; ore produced by open-cut methods was trucked 10 mi to the gravity-flotation-type mill, which produced both standard-grade concentrates and low-grade material which was shipped to Salt Lake City for final treatment. At the Glen mill, the company introduced a bonus system based on both the tons of ore milled and the percentage of recovery obtained.

Ores shipped to custom mills were the source of over 10% of the domestic output of tungsten concentrates. Custom plants near Bishop, Calif., and Salt Lake City, Utah, also beneficiated low-grade concentrates, which were, in large part, the product of flotation units. Similar low-grade concentrates were treated by acid leaching, and Nevada Scheelite division of Kennametal, Inc., installed equipment for this process at its mill near Rawhide.

Consumption of tungsten concentrates declined during 1954 and, during the third quarter of the year, reached the lowest quarterly rate since 1949. Preliminary data indicate that one-third of the concentrates was used by the steel industry, either directly or in the form of ferrotungsten; the remainder was largely used to manufacture tungsten metal and chemicals.

World production declined during 1954, largely because of declining prices or expiration of purchase contracts. Mines in the Republic of Korea, which had made that nation the fourth most important source of tungsten in the world and far the greatest single source of U. S. imports, were closed when a purchase contract with the U. S. Government expired.

Price: *E&MJ* 1954 quotations, duty not included, for spot lots of standard-grade imported tungsten concentrates were in the range $15 @ 20 per short ton unit to $30 @ 33; however, for much of the year the quotations were $24 @ 28. These prices were considerably lower than those of 1953, which opened at $51.50 @ 52.50 and were $24 @ 32 at year end. Domestic concentrates of standard grade sold at $63 per short-ton unit, and much of the imported concentrates was delivered against contracts calling for prices well above spot-lot quotations.

General imports (receipts) of tungsten ores and concentrates into the U. S. during the first 9 months were 18,612,000 lb metal content, compared with 24,470,000 lb for the same period of 1953. Republic of Korea (4,289,000 lb), Bolivia (3,617,000 lb), Spain (2,829,000 lb), Portugal (1,523,000 lb) and Australia (1,022,000 lb) supplied 71% of the total for the first 9 months of 1953. Imports of ferrotungsten for the same period contained 410,000 lb of tungsten.

Research on tungsten recovery from western ores was in progress by the Bureau of Mines and by private firms. Manufacturers of tungsten carbide products developed methods for production of larger units and predicted expanded use in such products as steel-mill rolls. During the year there was also considerable research in high-temperature alloys, welding electrodes, and methods for coating products.

Outlook: On July 1, 1958, or when 3-million short-ton units have been delivered, the present Domestic Tungsten Program will terminate. If the recent rate of production is maintained, the 3-million units will have been delivered in 1956. Inasmuch as the world market price for tungsten concentrates is about half that paid by the Government and because industrial consumption is so much less than production, domestic producers are understandably concerned•

Nickel Statistics

Short tons	1953	1954 (est.)
United States:		
Imports	118,700	130,000
Consumption	105,681	94,000
Canada:		
Production	143,966	160,000
Exports	145,117	158,000
Cuba:		
Production	13,844	14,600
Price per lb.*	56½-60c	60-64½c

*Electrolytic nickel in carlots at Port Colborne, Ont., including duty of 1¼ c.

NICKEL

Hubert W. Davis
U. S. Bureau of Mines

As a result of expansion of nickel-producing facilities, which has been underway, free-world output of nickel will probably be about 190,000 short tons in 1954, a gain of about 15% over 1953. Despite the increased supply and a reduction in military requirements, insufficient nickel was available for civilian needs in 1954, chiefly because of the stepped-up Government stockpiling program.

Production: Canadian output during the first 9 months was 116,994 short tons (up 10%), and exports were 118,548 tons (up 9%). Output of nickel oxide in Cuba was 13,400 tons (nickel content) in the first 11 months of 1954 (up 7%). Initial commercial production and shipments of oxide sinter were made by the Nicaro (Cuba) plant during June.

Imports of nickel into the United States were 11% more in the first 10 months of 1954 than in the corresponding period of 1953. Receipts from Canada, Cuba, and Norway were greater by 10%, 9%, and 2%, respectively. Imports from France were 1,348,000 lb in the first 10 months compared with 505,700 lb in entire year 1953, but receipts from Japan were only 490,800 lb compared with 917,200 lb in entire year 1953.

Consumption in the U. S. is estimated at 94,000 short tons for 1954, or 11% less than in 1953. Losses were most pronounced for stainless and engineering alloy steels, high-temperature and electrical-resistance alloys, and magnets, but less was also used in cast irons and nonferrous metals. Use of nickel in electroplating and ceramics was larger and that for catalysts about the same as in 1953.

Output by International Nickel Co. of Canada, Ltd., was moderately larger than in 1953. The company began making deliveries of metallic nickel at the rate of 2-million lb a month under its contract with GSA to supply 60,000 tons, which will be recovered from nickel-bearing pyrrhotite. Daily capacity of the concentrator at the Creighton mine was expanded to 12,000 tons. Inco signed an agreement with GSA to refine a quantity of nickel concentrate produced by Sherritt Gordon Mines, Ltd., at Lynn Lake, Manitoba, and to deliver to the U. S. Government a minimum of 4,500,000 lb of refined nickel. The concentrate to be refined by Inco represents an excess of mine production at Lynn Lake over the quantity required for processing at Sherritt Gordon's refinery.

Output by Falconbridge Nickel Mines, Ltd., was also larger than in 1953. Construction work on the surface plants at the various properties made good progress, and underground development continued at a satisfactory rate. The Hardy, East and Mount Nickel Mines were brought into production. Shaft sinking at Fecunis made good progress, and underground development was begun at the Longvack mine. A Cottrell dust collector and a pilot plant for research on a pyrrhotite process were under construction at the Falconbridge installation.

Sherritt Gordon Mines, Ltd., began production of nickel powder on July 22 at its chemical metallurgical plant at Fort Saskatchewan, Alberta. No troubles were encountered with the new process.

Hanna Nickel Smelting Co. expected to have two furnaces in operation at Riddle, Ore., by Jan. 1, 1955.

National Lead Co. at Fredericktown, Mo., was expected to begin commercial production early in 1955 in its nickel-cobalt copper separation plant.

The Bureau of Mines, under an agreement with GSA, completed drilling in the Levisa Bay district of Cuba. A total of 34,789,000 short tons of ore averaging 1.39% nickel, 0.10% cobalt, and 35.8% iron was indicated by the exploration project. A 75% expansion of the facilities at the Government-owned nickel plant at Nicaro, Cuba, was begun in October.

Freeport Sulphur Co. and GSA entered an agreement which provides for construction and operation by Freeport of a pilot plant to study, on a large scale, a new process for producing nickel and cobalt from deposits at Moa Bay on the northeast coast of Cuba. The plant, to be financed by the Government, will be near New Orleans and will treat 50 tons of ore per day supplied by Freeport without charge to the Government. In addition to the pilot-plant agreement, the Government entered into a contract to buy nickel and cobalt from the commercial plant that Nicaro Nickel Co., a Freeport subsidiary, plans to build upon successful completion of the pilot-plant program. The agreement provides for possible purchase by the Government of 150-million lb of nickel and 15-million lb of cobalt at prevailing market prices by June 30, 1963.

Price: Effective Nov. 24 International Nickel announced an increase by 4½c a lb in the price of its refined nickel. Similar price changes were announced for nickel oxide sinter and other forms of primary nickel. This brings the export price of electrolytic nickel from Port Colborne, Ont., to 64½c per lb, including the U. S. import duty of 1¼c. The former price of 60c per lb had been in effect since Jan. 14, 1953.

Forecast. Free-world production of nickel will probably exceed 200,000 short tons in 1955; but, as most of the increase is under contract to be delivered to the Government, it probably will go to stockpiling•

MANGANESE

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U. S. Bureau of Mines

DECREASED STEEL PRODUCTION in 1954 resulted in a corresponding decline in consumption of manganese ore. Imports dropped sharply but domestic production of ore exceeded the previous year's output, to be the greatest since World War II. Industrial stocks of ore reached a record high of over 1¾-million tons during the course of the year.

Production: For the first time since inception of continuous production from Montana in 1916, that state relinquished its position as the nation's leading producer of manganese ore (ore, concentrate, and nodules). Manganese, Inc., at Henderson, Nev., processed oxide ore from the Three Kids mine at a substantial rate, producing nodules exceeding 45% manganese content, to give Nevada first place, while Anaconda Copper Mining Co. continued its production of nodules of higher grade from carbonate ore from the mines at Butte, Mont.

Purchases of manganese ore by the Government through GSA under the so-called "carload lot" program were responsible for materially increased production from Arkansas, Tennessee, and Virginia. Result of all this activity was that total domestic production of manganese ore, containing 35% or more manganese, approximated 200,000 short tons. Less than 10% of this quantity was battery grade, of which a portion was synthetic battery ore produced by Western Electrochemical Co. at Henderson, Nev., from low-grade western ores.

Shipments of ferruginous manganese ores and manganiferous iron ores for the year amounted to roughly ¾-million tons, coming largely from Minnesota. In addition to the above production, manganese-bearing ores, mostly of low grade, poured into the GSA depot at Wenden, Ariz., almost filling its quota of 6-million long-ton units, while receipts at Deming, N. Mex., Butte and Philipsburg, Mont., were at accelerated rates.

Final registration date for participation in all the GSA domestic purchase programs, including the "carload lot" program, was extended another year to June 30, 1955; the closing date for all programs remained at June 30, 1958, or fulfillment of quota, whichever might occur first. Minimum acceptable manganese content, limited to ores amenable to beneficiation to national stockpile specifications, continued to be 15% at Wenden, Deming, and (for carbonate ore) at Philipsburg and 12% for carbonate ore at Butte. The 18% minimum for oxide ore at Butte or Philipsburg was lowered in July to 15%.

Manganese-Ore Statistics

(Short tons)*

	1953	Estimated 1954
Domestic production	157,536	200,000
Domestic consumption	2,195,742	1,700,000
Exports	6,894	6,000
Imports	3,500,986	2,250,000

*Includes all ore 35% or more manganese.

Interest continued in the Defense Minerals Exploration Administration program as a source of aid in the exploration of manganese deposits. In the case of authorized manganese projects, DMEA will participate in the approved exploration costs to the extent of 75%, the money to be repaid from income on future production. Several new contracts for manganese projects were put into effect during the year, and a certificate of discovery was issued for an earlier one.

U. S. consumption of manganese ore was lower than that of the last three years, and production of ferromanganese at 700,000 short tons was similarly only three quarters that of 1953. Ferromanganese imports of 50,000 short tons were less than half those of the preceding year, coming principally from France, Norway, and West Germany.

U. S. imports of manganese ore by the end of September had exceeded 1.8-million short tons, and it appeared that the year's total would be in the neighborhood of 2¼-million tons. India continued to be the principal supplier; and that country, with Union of South Africa, Cuba, and the Gold Coast, again provided three-fourths of the total U. S. imports. Shipments from Belgian Congo increased considerably, and those from Brazil and Mexico also rose.

Price: Lack of interest in new purchases of ore on the part of buyers and the fact that Russian ore was again a factor in world trade were largely responsible for a marked decline in commercial prices of manganese ore. Indian ore of 46 to 48% manganese content, as quoted by the *E&MJ Metal and Mineral Markets*, dropped from $1.08 @ $1.10 to a low of 70 @ 75c. per long-ton unit of manganese, c.i.f. U. S. ports, duty extra. The greater portion of this price decrease occurred in the one month of September, with a little improvement being noted in December. Quotations for long-term contracts for ore from various sources declined similarly from 90c nominal to a low of 65 @ 70c nominal on the same basis, also with some improvement in December. Throughout the year, U. S. Government prices for domestic ores purchased under the domestic purchase programs remained based on $2.30 per long-ton unit for ore of 48% manganese content. Effective September, the price of standard ferromanganese of 74 to 76% manganese content was cut $10 per net ton to $190.

The lack of demand for ore of average grade and the drop in price had their effect upon most of the ore-producing countries, and one result was abolition of the Indian 15% export tax.

Work proceeded on development of the large manganese-ore deposits in Amapa Territory, Brazil.

In India the country's largest producer, Central Provinces Manganese Ore Co., Ltd., officially opened its new heavy-medium separation plant at the Dongri Buzurg mine in Madhya Pradesh; it is the first such plant in India.

Research work by the U. S. Bureau of Mines and others continued on the recovery of manganese from low-grade manganese-bearing materials, as well as upon other aspects of the manganese supply situation, including that of substitutes for manganese in the production of steel.

Forecast: Domestic production of manganese ore of 35% or more manganese content in 1955 will depend largely on the domestic purchase program of GSA and should equal or exceed that of 1954. Activity in the manganese-consuming industry will follow the fortunes of steel. Many connected with the steel industry feel that 1955 will be a better year for them than the one just passed. Owing to the high level of industrial stocks, however, it is believed that no great change can be expected in commercial prices for ore•

MINOR METALS

Charles White Merrill
U. S. Bureau of Mines

MINOR METALS during 1954 were featured by a general drop in consumption, ample supplies for commercial purposes except for selenium, and many price declines. Lower demand and prices tended to depress domestic mine output, but the production of a few metals, notably mercury, rose sharply. Likewise, imports as a whole were lower, but plentiful foreign supplies, lower prices and stockpile procurement resulted in higher receipts in some instances.

Research workers were reported very active in adapting the special properties of some of the minor metals to newer applications. The use of rare-earths in special steels, thorium as a source of atomic energy, beryllium in new alloys and selenium in rectifiers, exemplifies promising expanding demand for the future•

BERYLLIUM

Horace T. Reno
U. S. Bureau of Mines

WORLD BERYL PRODUCTION in 1954 dropped about 40% below the record high established in 1953. Domestic production, despite a 20% decrease, remained above the pre-Korean War level. Beryl supply was more than ample, and the beryllium industry experienced the first full year since 1946 without some sort of national defense regulation. The market price for foreign ores dropped rapidly from $46 to $39 per short-ton unit of BeO in the last half of the year, with some sales reported as low as $36. Domestic prices, $40 to $50 a unit, did not change.

Beryl Statistics

Short tons	1953	Preliminary 1954
World production	8500	5500
Domestic production (mine shipments)	751	615
United States imports	8245	5000
Total new supply	8996	5615
Commercial consumption	2661	2500
Average domestic and foreign price per short ton unit BeO (10-12% BeO)	$47.00	$43.00

Production: Preliminary data indicate that Mozambique and India were the only countries that produced more beryl in 1954 than in 1953. Mozambique increased its production almost 100%—the result of better management, by-product recovery of beryl in columbite-tantalite mines, and new production from known deposits. No new discoveries were reported. India's production increased about 10%. Brazil decreased 50%, Portugal 42%, and Union of South Africa about 10%. Argentina, in the past a large producer, did not report any output in 1954. It is usually withheld by IAPI, the monopoly purchasing agency of the Argentine Government.

Purchases: Government price for domestic beryl is apparently not high enough to have much effect on United States beryl production, although several new deposits have been found since the purchasing program went into effect—the DMEA program was probably as much responsible for the new discoveries as the premium price. Preliminary data indicate that South Dakota production, augmented by many new small producers, increased about 7% above the all-time record established in 1953. Georgia production, principally from two mines opened up under DMEA loans, increased; but Colorado, New Hampshire, Maine, and New Mexico decreased, bringing the total 1954 production below 1953. Government depots purchasing domestic ores have bought only 527 tons of beryl since the program was begun on Oct. 7, 1952; at this rate of purchasing, the 1,500 tons authorized will not be obtained before the program ends on June 30, 1957.

Brazil maintained the position of principal supplier of beryl to the U. S. by a narrow margin, although the Brazilian Government waited until June to announce a 1954 export quota of 4,000 tons. India filled its export quota in February, probably from stocks held over from 1953. Argentina did not establish an export quota. Brazil supplied 29% of U. S. imports in 1954, Mozambique 22%; Union of South Africa 20%; Southern Rhodesia 19%; India 5%; Portugal 4%, and Pakistan, Korea, Belgian Congo, and Sweden collectively less than 1%. Although Madagascar relaxed beryl export restrictions to allow shipments to the U. S., none of its 500- to 600-ton stockpile has been received.

Free-World reserves of ore, sufficiently high grade to be hand cobbed, have increased, despite the record rate of production of the past few years. Argentine reserves, for example, were supposed to have been exhausted by 1951 or early 1952, but in 1953 Argentina was still mining and exporting beryl. After three years of record high production, the South Dakota reserves are apparently larger than ever. Georgia now has two producing mines.

World stocks of beryl are the highest in history. Total U. S. supply of beryl in 1954 was about 3,000 tons more than commercial consumption, adding that quantity to the already large inventory. Brazil probably retained a large quantity of beryl while waiting for the new export quota to be released, and Madagascar stocks are known to be 800 or more tons. India filled its 200-ton quota for export shipment to the U. S. from 1953 stocks, but production in 1954 has replaced that quantity twice over.

Uses: Beryllium-copper alloys are unequaled in nonmagnetic, strength, hardness, fatigue-resistance, high-electrical, and thermal-conductivity applications. Research in 1954 was aimed at producing ductile beryllium. The problem has not been completely solved, but vacuum-sintered beryllium has been cold rolled to a 10% decrease in thickness without showing any signs of deterioration.

Outlook: Several factors brighten the outlook of the beryllium industry. The difficult postwar adjustment period is largely behind it; raw material is available in sufficient quantity to insure against repetition of a feast-famine pattern of supply; the industry is free from regulation; and production facilities are available to supply an expanded market•

E & M J Annual Average Metal Prices—1897 to 1954

Year	COPPER (a) Electrolytic Refinery	COPPER Export or Foreign Refinery	LEAD, Common, N. Y.	ZINC, Prime Western (b) E. St. Louis	TIN, (c) N. Y.	SILVER, (e) N. Y.	QUICKSILVER, (f) N. Y.	ALUMINUM Ingot
1897	11.29	.....	3.580	4.120	13.67	59.790	38.50	39.00
1898	12.03	.....	3.780	4.570	15.70	58.260	40.70	30.58
1899	16.67	.....	4.470	5.750	25.12	59.580	43.63	32.72
1900	16.19	.....	4.370	4.390	29.90	61.330	51.00	32.72
1901	16.11	.....	4.330	4.070	16.74	58.950	47.00	33.00
1902	11.026	.....	4.069	4.840	26.79	52.160	48.03	33.00
1903	13.235	.....	4.237	5.191	28.09	53.570	41.32	33.00
1904	12.823	.....	4.309	4.931	27.99	57.221	41.00	35.00
1905	15.590	.....	4.707	5.730	31.358	60.352	38.50	35.00
1906	19.278	.....	5.657	6.048	39.819	66.791	40.90	35.75
1907	20.004	.....	5.325	5.812	38.166	65.237	41.50	45.00
1908	13.208	.....	4.200	4.578	29.465	52.864	44.84	28.70
1909	12.982	.....	4.273	5.352	29.725	51.502	46.30	22.00
1910	12.738	.....	4.446	5.370	34.123	53.486	47.06	22.25
1911	12.376	.....	4.420	5.608	42.281	53.304	46.54	20.07
1912	16.341	.....	4.471	6.799	46.096	60.835	42.46	22.01
1913	15.269	.....	4.370	5.504	44.252	59.791	39.54	23.64
1914	13.602	.....	3.862	5.061	34.301(d)	54.811	48.31	18.63
1915	17.275	.....	4.673	13.054	38.590	49.684	87.01	33.98
1916	27.202	.....	6.858	12.634	43.480	65.661	125.49	60.71
1917	27.180	.....	8.787	8.813	61.802	81.417	106.30	51.59
1918	24.628	.....	7.413	7.890	88.750	96.772	123.47	33.53
1919	18.691	.....	5.759	6.988	63.328	111.122	92.15	32.14
1920	17.456	.....	7.957	7.671	48.273	100.900	81.12	32.72
1921	12.502	.....	4.545	4.655	29.916	62.654	45.46	21.11
1922	13.382	.....	5.734	5.716	32.554	67.528	58.95	18.68
1923	14.421	.....	7.267	6.607	42.664	64.873	66.50	25.41
1924	13.024	.....	8.097	6.344	50.176	66.781	69.76	27.03
1925	14.042	.....	9.020	7.622	57.893	69.065	83.13	27.19
1926	13.795	.....	8.417	7.337	65.285	62.107	91.90	26.99
1927	12.920	.....	6.755	6.242	64.353	56.370	118.16	25.40
1928	14.570	.....	6.305	6.027	50.427	58.176	123.51	24.300
1929	18.107	.....	6.833	6.512	45.155	52.993	122.15	24.300
1930	12.982	.....	5.517	4.556	31.694	38.154	115.01	23.787
1931	8.116	.....	4.243	3.640	24.467	28.700	87.35	23.300
1932	5.555	.....	3.180	2.876	22.017	27.892	57.93	23.300
1933	7.025	6.713	3.869	4.029	39.110	34.727	59.23	23.300
1934	8.428	7.271	3.860	4.158	52.191	47.973	73.87	23.300
1935	8.649	7.538	4.065	4.328	50.420	64.273	71.99	20.000
1936	9.474	9.230	4.710	4.901	46.441	45.087	79.92	20.000
1937	13.167	13.018	6.009	6.519	54.337	44.883	90.18	19.917
1938	10.000	9.695	4.739	4.610	42.301	43.225	75.47	20.000
1939	10.965	10.727	5.053	5.110	50.323	39.082	103.94	20.000
1940	11.296	10.770	5.179	6.335	49.827	34.773	176.86	18.691
1941	11.797	10.901	5.793	7.474	52.018	34.783	185.02	16.500
1942	11.775	11.684	6.481	8.250	52.000	38.333	196.35	15.000
1943	11.775	11.700	6.500	8.250	52.000	44.750	195.21	15.000
1944	11.775	11.700	6.500	8.250	52.000	44.750	118.36	15.000
1945	11.775	11.700	6.500	8.250	52.000	51.928	134.89	15.000
1946	13.820	14.791	8.109	8.726	54.544	80.151	98.24	15.000
1947	20.958	21.624	14.673	10.500	77.949	71.820	83.74	15.000
1948	22.038	22.348	18.043	13.589	99.250	74.361	76.49	15.733
1949	19.202	19.421	15.364	12.144	99.336	71.930	79.46	17.000
1950	21.235	21.549	13.296	13.866	95.539	74.169	81.26	17.713
1951	24.200	26.258	17.500	18.000	127.077	89.368	210.13	19.000
1952	24.200	31.746	16.467	16.215	120.473	84.941	199.097	19.410
1953	28.798	30.845	13.489	10.855	95.845	85.188	193.032	20.931
1954	29.694	29.889	14.054	10.681	91.838	85.250	264.386	21.784

(a) Lake copper 1897-98: domestic market since 1932. (b) New York delivery 1898-1902. (c) 99 per cent in 1897 to 1920, inclusive: Straits quality thereafter. (d) Average for eleven months. (e) New York market.

All quotations in cents per lb, except for silver, which are in cents per troy oz, and (f) quicksilver, which are in dollars per flask of 76 lb.

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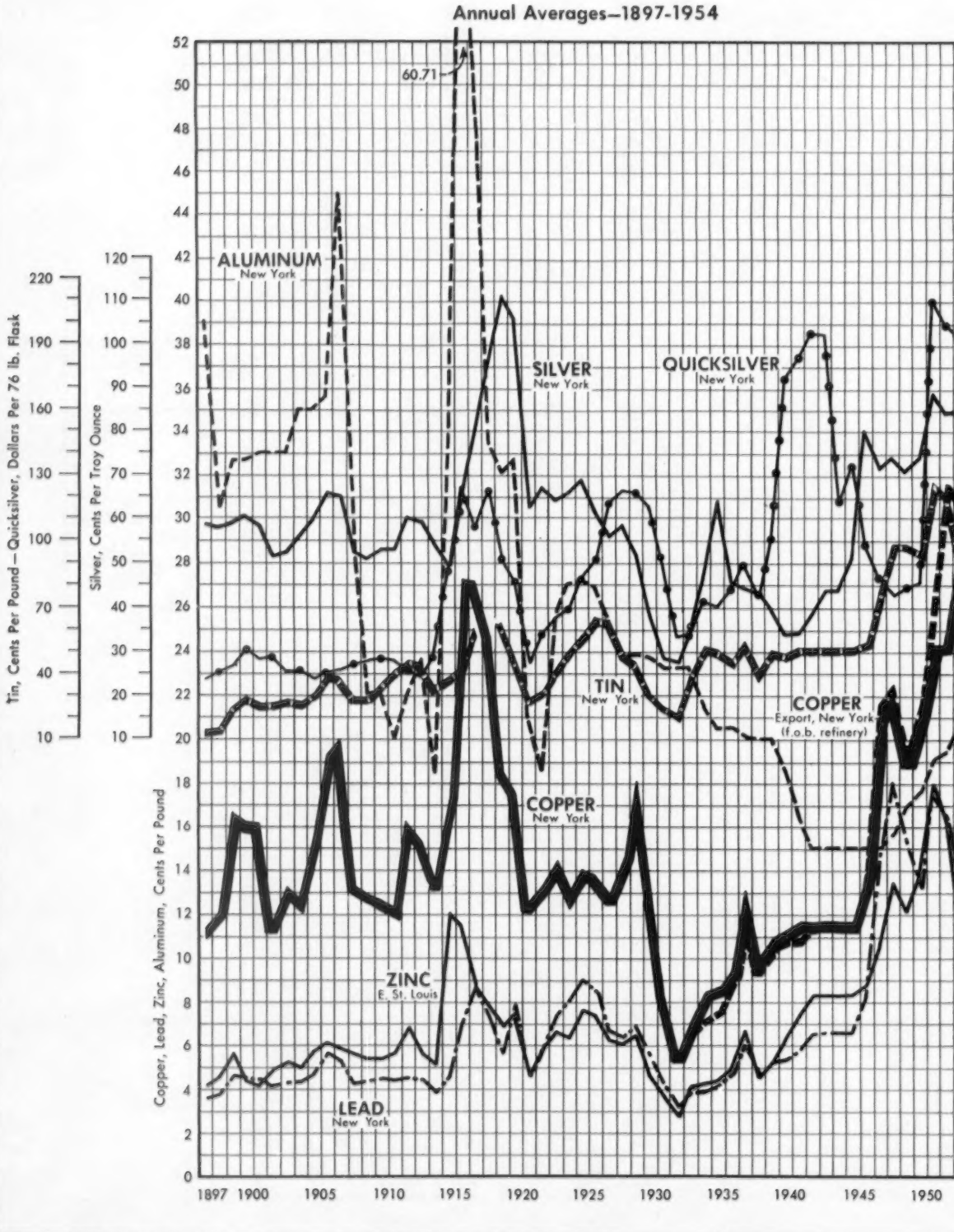

etal Prices

Journal and E&MJ Metal and Mineral Markets

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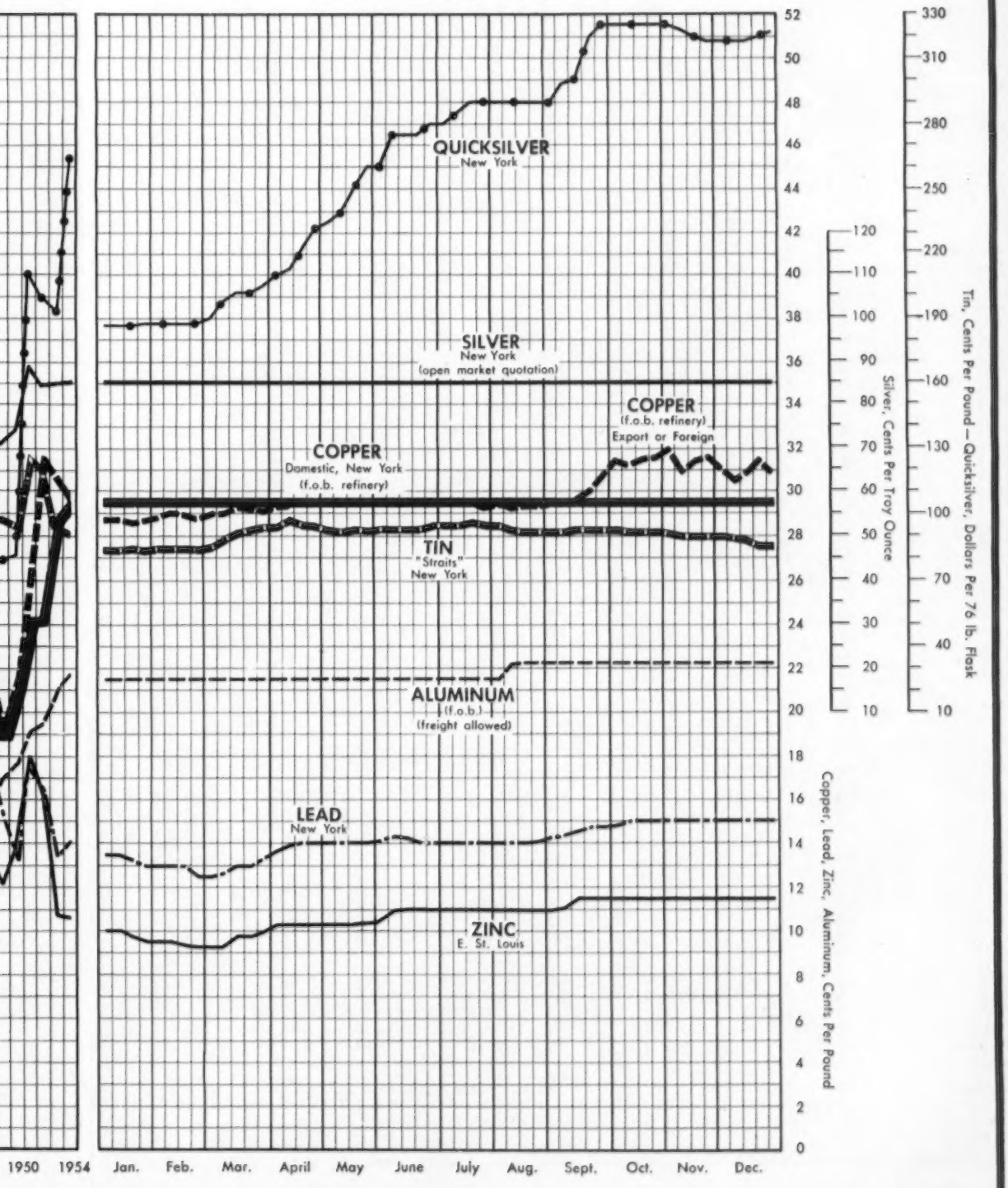
Weekly Averages—1954



E & M J Weekly Average Metal Prices—1954

	COPPER		LEAD	ZINC	TIN	SILVER	QUICK-	ALUM-
	Domestic Refinery	Foreign, Refinery	N. Y., Common	E. St. Louis Prime Western	N. Y., "Straits"	N. Y., Foreign	SILVER N. Y.	INUM 99% plus, Ingot
Jan. 6	29.669	28.820	13.500	10.000	84.750	85.250	187.000	21.500
13	29.695	28.833	13.500	10.000	84.750	85.250	187.000	21.500
20	29.660	28.721	13.250	9.750	84.917	85.250	187.000	21.500
27	29.655	28.838	13.000	9.500	84.792	85.250	188.000	21.500
Feb. 3	29.675	28.900	13.000	9.500	85.000	85.250	188.000	21.500
10	29.675	29.079	13.000	9.500	85.125	85.250	188.000	21.500
17	29.656	29.033	13.000	9.350	85.000	85.250	188.000	21.500
24	29.669	28.842	12.500	9.250	84.900	85.250	188.000	21.500
Mar. 3	29.685	29.008	12.500	9.250	85.958	85.250	190.000	21.500
10	29.685	29.025	12.625	9.250	88.667	85.250	198.000	21.500
17	29.680	29.279	13.000	9.750	92.250	85.250	202.000	21.500
24	29.680	29.213	13.000	9.750	94.208	85.250	202.000	21.500
31	29.700	29.175	13.333	9.992	94.750	85.250	205.000	21.500
Apr. 7	29.700	29.404	13.710	10.250	94.958	85.250	210.000	21.500
14	29.700	29.433	13.875	10.250	97.833	85.250	212.000	21.500
21	29.700	29.633	14.000	10.250	96.625	85.250	222.000	21.500
28	29.700	29.571	14.000	10.250	96.167	85.250	232.000	21.500
May 5	29.700	29.667	14.000	10.250	94.000	85.250	235.000	21.500
12	29.700	29.654	14.000	10.250	93.250	85.250	240.000	21.500
19	29.700	29.658	14.000	10.250	93.917	85.250	250.000	21.500
26	29.700	29.663	14.000	10.275	93.417	85.250	260.000	21.500
June 2	29.700	29.638	14.050	10.500	94.150	85.250	260.000	21.500
9	29.700	29.646	14.250	10.992	93.708	85.250	275.000	21.500
16	29.700	29.596	14.167	11.000	93.688	85.250	275.000	21.500
23	29.700	29.554	14.000	11.000	93.771	85.250	275.000	21.500
30	29.700	29.600	14.000	11.000	95.625	85.250	280.000	21.500
July 7	29.700	29.625	14.000	11.000	96.550	85.250	280.000	21.500
14	29.700	29.646	14.000	11.000	96.521	85.250	285.000	21.500
21	29.700	29.579	14.000	11.000	97.146	85.250	290.000	21.500
28	29.700	29.475	14.000	11.000	96.417	85.250	290.000	21.500
Aug. 4	29.700	29.550	14.000	11.000	95.646	85.250	290.000	21.500
11	29.700	29.413	14.000	11.000	93.813	85.250	290.000	22.142
18	29.700	29.492	14.000	11.000	92.667	85.250	290.000	22.200
25	29.700	29.467	14.042	11.000	92.938	85.250	290.000	22.200
Sept. 1	29.700	29.563	14.250	11.000	92.938	85.250	290.000	22.200
8	29.700	29.642	14.350	11.142	92.925	85.250	298.000	22.200
15	29.700	29.675	14.533	11.500	93.604	85.250	300.000	22.200
22	29.700	30.050	14.750	11.500	93.833	85.250	320.000	22.200
29	29.700	30.758	14.750	11.500	93.750	85.250	325.000	22.200
Oct. 6	29.700	31.475	14.813	11.500	93.563	85.250	325.000	22.200
13	29.700	31.313	15.000	11.500	93.475	85.250	325.000	22.200
20	29.700	30.621	15.000	11.500	93.000	85.250	325.000	22.200
27	29.700	31.717	15.000	11.500	92.750	85.250	325.000	22.200
Nov. 3	29.700	32.033	15.000	11.500	92.225	85.250	325.000	22.200
10	29.700	30.954	15.000	11.500	91.063	85.250	323.000	22.200
17	29.700	31.500	15.000	11.500	91.250	85.250	320.000	22.200
24	29.700	31.675	15.000	11.500	91.000	85.250	318.000	22.200
Dec. 1	29.700	31.042	15.000	11.500	90.525	85.250	318.000	22.200
8	29.700	30.579	15.000	11.500	90.000	85.250	318.000	22.200
15	29.700	30.950	15.000	11.500	89.646	85.250	318.000	22.200
22	29.700	31.558	15.000	11.500	87.438	85.250	320.000	22.200
29	29.700	30.965	15.000	11.500	87.275	85.250	322.000	22.200

CADMIUM

Robert L. Mentch
U. S. Bureau of Mines

CADMIUM was in oversupply in the United States for the third successive year in 1954. Production at domestic plants was high, consumption was down, stocks accumulated and there was a reversal of the import-export position.

Total supply, consisting of production of metal at domestic plants and metallic imports, was approximately 9.6-million lb, or 15% below the historical peak of 1953.

Apparent consumption of primary cadmium declined from 9,267,000 lb in 1953 to about 7-million lb in 1954, lowest since 1946. Metal producers' shipments of cadmium, including internal plant consumption, decreased 5% to approximately 7,650,000 lb. Stocks advanced to a new high—inventories of metallic cadmium totaled about 5-million lb on Dec. 31, 1954, compared with stocks of 3,361,000 lb at the end of 1953.

Output of cadmium metal at U. S. plants in 1954 declined 5% from the 1953 record to about 9,250,000 lb.

Imports of metal in the first 9 months totaled 256,000 lb compared with 1,555,000 lb in all of 1953, while exports during the January-September period were 668,000 lb against 66,000 lb in 1953. This change in the import-export pattern was attributed to the stocks on hand at domestic plants, increased consumption in Europe, and a lower U. S. selling price.

On the basis of 9 months' data, Belgium-Luxembourg supplied 32% of the total imports, Canada 29%, Australia 22%, Japan 11%, and Peru 6%. West Germany and the United Kingdom received 40 and 39%, respectively, of the total U. S. exports of cadmium. Nine other countries accounted for the bulk of the remainder.

Price: Stated price of cadmium sticks and bars, delivered, in 1- to 5-ton lots, was reduced from $2.00 per lb to $1.70 on Feb. 1 where it remained for the balance of the year. Concurrently, the quoted price for special platers' shapes was lowered 40c per lb to $1.75 and on June 21 further reduced to $1.70.

Chief uses of cadmium are for electroplating, pigments, and silver-brazing alloys and other low-melting-point alloys, with electroplating by far the largest use. Introduction of new cadmium enamels has permitted car stylists to select colors considered impossible from a durability standpoint as recently as 3 years ago. Nickel-cadmium battery models (suitable for automobiles) containing 2 to 3 lb of cadmium have been manufactured in the U. S., but so far consumer acceptance has been limited. A solar generator using cadmium sulfide processed into a thin crystal form was developed by the Air Force in 1954 and found practical for many purposes.

Outlook: Activity in the cadmium industry in 1955 will be essentially unchanged from that in 1954, except with regard to production. Domestic output possibly will decrease, due to the huge stocks of metal on hand. Raw materials will probably be stockpiled to a greater extent, rather than processed immediately. Apparent consumption is expected to increase somewhat over the low level of 1954. Exports should exceed imports by a wide margin in 1954•

ANTIMONY

Abbott Renick
U. S. Bureau of Mines

PRIMARY ANTIMONY available for consumption in 1954 was about 13,000 short tons; in 1953, 15,000. USBM data shows January-September consumption down 16% from 1953's 14,300 tons.

U. S. mine production was 800 tons in 1954 (370 in 1953). Sunshine Mining Co. was principal producer. Bradley Mining Co.'s Yellow Pine mine at Stibnite, once the main U. S. source, and Hermada Mining Co.'s mine at Atlanta, Idaho, were down all year.

Domestic smelter production was 9,000 (estimated) against 7,100 in 1953. About 2,500 tons of antimony contained in lead and silver ores was recovered, 300 less than in 1953. Recovery of secondary antimony should approximate 21,000 tons, 5% below the previous year's figure.

General imports of primary antimony were about 9,700 tons (11,500 in 1953), coming from Bolivia, Mexico and Peru (ore and concentrates); Mexico, Belgium - Luxembourg and Yugoslavia (two-thirds of the metal); U. K. (oxide); and Belgium-Luxembourg (95% of the sulphide).

Quoted price for the year was 28.50c per lb (RMM brand, f.o.b. Laredo, carlots in bulk)—unchanged since Nov. 27, 1953. Foreign brand quotations remained below U. S. prices, as follows (duty paid, lots of 5 tons or more at New York):

99.6%	28.00 @ 28.50c per lb
99.5	27.00 @ 28.00c per lb
99.0	26.00 @ 27.00c per lb

Antimony Statistics

(Short tons)	1953	1954 (estimated)
Domestic mine production	370	800
General imports	11,500	9,700
Exports	24	50
Consumption of primary antimony	14,300	12,000
Average price, metal RMM brand, bulk, 99.5%, f.o.b. Laredo, c per lb	33.93c	28.50c

Demand for Bolivian chemical-grade ore was firm. *E&MJ Metal & Mineral Markets* price for 60-65% ore rose from $3.50 @ $3.60 per unit in March to $4.35 @ $4.45 in December. Year end price for refined antimony trioxide was 29c per lb bagged, carlots; 30½c per lb, less than carlots.

On Sept. 21, 1954, ODM forwarded a revised purchase directive covering procurement of domestic antimony for the long term stockpile to GSA. Antimony also came under the supplemental stockpile set up under the Agricultural Trade Development and Assistance Act of 1954.

Free World production of antimony ore is dominated by Mexico, Bolivia, Peru, Union of South Africa, Yugoslavia and Algeria (70% of non-Soviet production in 1953). Total was about 25,000 short tons in 1954, 10% over 1953•

ARSENIC

Abbott Renick
U. S. Bureau of Mines

THE U. S. is in a favorable position to meet the requirements for arsenic in the foreseeable future. It is unlikely that any new uses for arsenic or the compounds of arsenic will tax existing arsenic-producing capacity.

Production of both crude and refined white arsenic in the U. S. during 1954 was estimated at 12,500 short tons, an increase of 15% over 1953 (the lowest recorded since 1946).

Imports of arsenic trioxide for the first 9 months of the year were 3,500 short tons, with total imports for the year expected to remain virtually unchanged from the 4,700 tons in the preceding year. Imports of metallic arsenic for the same period totaled 34 tons, and total imports for the year were expected to decrease about 30% from the 70 tons received in 1953. Mexico continued to be the principal supplier of white arsenic, accounting for 86% of the total received, while Sweden supplied practically all of the metallic arsenic.

Apparent consumption of white arsenic in 1954 was expected to fall to 15,000 tons, a slight decrease under the 16,000 tons consumed during 1953.

Arsenic Trioxide

(Short tons)	1953	Estimated 1954
Production	11,000	15,000
Imports	4,700	4,700
Apparent consumption	16,000	15,000
Average price per lb	$0.05½	$0.05½

Price of white arsenic was reported throughout the year at 5½c per lb, carlots, delivered—unchanged since June 16, 1952.

Producers' stocks at the end of 1954 of white arsenic were expected to increase above the 10,800 tons reported on hand at the beginning of the year•

BISMUTH

Abbott Renick
U. S. Bureau of Mines

DOMESTIC PRODUCTION FIGURES cannot be divulged, but the 1954 output was estimated at about 10% under that of 1953.

The U. S. is not self-sufficient in bismuth. Much of the metal it consumes is imported or derived from imported raw materials. Virtually all the refined bismuth produced in the U. S. is recovered as a by-product in refining domestic and imported lead and copper ores and imported lead bullion.

Total imports of bismuth metal based on data for the first 9 months, excluding bismuth contained in lead bullion from Mexico and Peru, would be higher than in 1953. Of 500,000 lb imported through September, approximate supply by countries was Peru 62%, Yugoslavia 13%, Korea 13%, Mexico 9%, and other 3%.

Major output of bismuth in Mexico was imported as bismuth-lead bars for refining in the U. S. Exports of bismuth metal and alloys in 1954 were expected to increase about 57% over the 1953 exports. The United Kingdom was again the principal recipient.

Demand for bismuth based on data for the first 9 months, particularly in the form of refined metal, was expected to be under that of 1953. Estimates for 9 months domestic consumption indicated that metal products consumed 64% and the pharmaceutical industry 36%.

New York market price of high-quality metallic bismuth remained at $2.25 per lb in ton lots, unchanged since Sept. 5, 1950•

Bismuth Metal

(Pounds)	1953	Estimated 1954
Consumption	1,568,000	1,200,000
Imports	641,400	666,000
Exports	117,300	184,000
Average New York price per lb, in ton lots	$2.25	$2.25

PLATINUM

James E. Bell
U. S. Bureau of Mines

THE PLATINUM-GROUP METALS were highlighted in 1954 by a growing world production potential, with declining prices for most metals in consequence, despite continuing strong demand.

Production: Preliminary estimate of production of platinum-group metals in 1954 is as follows (in troy oz): Union of South Africa 310,000; Canada 300,000; USSR 100,000; Colombia 30,000; U. S. 25,000; total world production 765,000.

Platinum Group Prices

	Range
Platinum (oz troy)	$84 – $93
Palladium (oz troy)	$21 – $24
Iridium (fine oz troy)	$130 – $175
Osmium (fine oz troy)	$140 – $150
Rhodium (fine oz troy)	$118 – $125
Ruthenium (fine oz troy)	$60 – $80

Total imports of platinum-group metals, crude and refined, into the U. S. were 417,000 oz troy, or 7%

less than in the corresponding period of 1953; total domestic refining was 73,000 oz, or 1% less; and total domestic consumption was 384,000 oz, or 12% greater.

Platinum: In the first 9 months imported and domestically refined platinum totaled 265,000 troy oz compared with 269,000 oz in the corresponding period of 1953. Domestic sales plus exports in the same periods were 216,000 and 178,000 oz, respectively. The distribution of domestic consumption of platinum by uses, as measured by sales in the first 9 months of 1954, was as follows: chemical 67%, electric 17%, dental 1% and medical 4%, jewelry and decorative 11%. Noteworthy were the gains in sales for chemical uses and for jewelry. Platinum was purchased by the Government for stockpiling, but this metal is not included in the figures given.

Palladium: Imported and domestically refined palladium totaled 166,000 troy oz in the first 9 months of 1954, as against 204,000 oz in the same period of 1953; domestic sales and exports together were 167,000 and 166,000 oz, respectively. Sales data indicate the following distribution, by uses, for palladium domestically consumed: chemical 8%, electrical 66%, dental and medical 12%, jewelry and decorative 9%, and miscellaneous 5%.

Imports of refined iridium, osmium, rhodium, and ruthenium together, plus domestic refining of these four metals totaled 21,000 troy oz in the first 9 months of 1954 compared with 20,000 oz in the same period of 1953. Domestic sales of the four metals together totaled 19,000 troy oz in the first 9 months of 1954, comparable to 17,000 oz in the corresponding period in 1953. The largest user was the chemical industry, which accounted for 42% of the total.

Outlook for platinum-group metals for 1955 is for slightly greater world production than in 1954 and continued strong demand, largely because of requirements of the oil industry•

Authorizations For Thorium Procurement

(Non Atomic Energy Uses)

Pounds, contained thoria (ThO_2)	1953[1]	Estimated 1954[2]
Magnesium alloys	3,600	4,500
Gas-mantle manufacture	8,707	6,000
Refractories and polishing compounds	236	500
Chemical and medical	5,179	5,000
Electrical	1,222	1,000
Total ThO_2	18,944	17,000

[1]Reported by the U.S. Atomic Energy Commission

[2]Estimated by the U.S. Bureau of Mines

Thorium Prices in 1954

Thorium nitrate, mantle grade (lb)	$3.00
Thorium oxide, 97% ThO_2 (lb)	8.25
Thorium metal powder (gm)	0.35(a)
Thorium metal bars (gm)	0.40(a)
Thorium metal bars, sintered (gm)	0.50(a)
Thorium metal sheet (0.005 in. and over) (gm)	0.60(a)
Thorium metal sheet, (0.002 in. to 0.0049 in.) (gm)	0.70(a)

(a) 200 gm or more

THORIUM

John E. Crawford
U. S. Bureau of Mines

THORIUM AS A SOURCE of fissionable material for power reactors may become a reality in 5 years. At present these are the chief thorium consumers:

Incandescent mantles: Historically, the greatest use for thorium as thorium oxide, has been in the manufacture of incandescent mantles for gas and gasoline lamps and lanterns. Since 1950, however, this use has steadily declined. While AEC has not yet released statistics on thorium authorized for consumption in 1954, it is estimated that slightly more than one-third went to the gas mantle industry. Lindsay Chemical Co. closed its gas-mantle facilities during the year. In 1955 thoria for gas mantles may become a minor item in the overall consumption pattern.

Magnesium alloys: Thorium was first authorized by the AEC for use in magnesium alloys in 1953 and it is now one of the significant uses. Addition of 2 to 3% thorium is said to improve mechanical qualities of magnesium alloy at ambient and elevated temperatures. Signs are that possibly more thorium was allowed for alloying in 1954 than in 1953 and all of it for the military aircraft program. These alloys are particularly suited to castings of compressor components for gas-turbine aircraft engines. With transition from experimental to production phase much greater quantities of thorium will be required for magnesium alloys within the next year or two for jet-engine manufacture alone.

Chemical industry: Consumption by the chemical industry and medical field in 1954 was probably about the same as in 1953, and there are no indications that any significant increase should be expected. It has been reported that some new uses for thorium as a catalyst are being developed but none of these are yet of commercial interest.

Electrical Industry: Requirements of the electrical industry in 1954 were probably no greater than the 1,222 lb of contained thoria authorized for such use in 1953.

Refractories: About 500 lb of thoria equivalent was consumed in refractories and polishing compounds. It is doubtful that 1955 will see much change.

During 1954 the AEC announced that a homogeneous thorium breeder reactor would be constructed in the near future, using a blanket of thorium from which it is hoped fissionable uranium-233 can be produced in quantities as great as the fissionable material consumed in the fuel unit.

The Lindsay Chemical Co. completed construction of a new thorium-compound production facility in 1954 and can now produce more thorium compounds that all other manufacturers combined•

RARE EARTH METALS

Frank D. Lamb
U. S. Bureau of Mines

DEVELOPMENTS in the use of rare-earth metals in the iron and steel industry in 1954 resulted in increased interest in these little-known elements, obtained from bastnaesite and monazite ores.

Addition of small quantities of rare earths to steel results in improved properties and greater yield of finished steel, but heretofore the cost has been prohibitive, except for certain high-priced stainless and high-alloy steels. Development of a new rare-earth additive and reduction in price from $1.50 to $1 a lb by the Molybdenum Corporation of America now justifies increased experimental use of rare earths as additives to lower priced steels.

Molybdenum Corp.'s bastnaesite deposit in California contains some billions of pounds of rare-earth metals and is mined by open-pit methods. Mill recovery is by flotation, followed by roasting. Steady improvements in metallurgical results and increased production have resulted in a lower price for the rare-earth additive and now assure the U.S. of complete independence from foreign sources.

Monazite, a source of thorium as well as rare-earth compounds, continued to be mined on a moderate scale in Idaho and Florida. Two dredges were operated near Cascade, Idaho; each handled 4,000 to 6,000 cu yd of gravel and recovered approximately 2 tons of monazite per day. In Florida, small quantities of monazite were separated from the heavy sands recovered from beach and dune deposits for their titanium-mineral content.

Increased tonnage of monazite was imported in 1954 from the Union of South Africa, where a massive lode deposit was being mined in the van Rhynsdorp district of Cape Province. Monazite concentrates from Korea, Ceylon, and Australia were also for sale in the U.S., as were processed rare-earth compounds from Brazil and India.

Additional domestic monazite will be available in 1955, when Porter Bros. Corp., in Bear Valley, Idaho, and Marine Minerals, Inc., near Aiken, S.C., reach full production with their 6-ft bucketline dredges. Each operation will recover monazite as a co-product with other important strategic minerals.

Increasing consumption of rare-earth metals by the iron and steel industry appears certain as the cost goes down. Their use in high-alloy steels is widely practiced; and, with additional price reductions resulting from a larger maket and technical improvements, rare earths will be employed in producing many more low-carbon steels.

Outlook: Consumption of rare-earth compounds for the older applications, such as those in the glass industry, probably will increase as more and more of these compounds become available from both monazite and bastnaesite. Thus it is reasonable to assume that in 1955, supply and demand for rare earths will increase substantially•

SELENIUM

John D. Sargent
U.S. Bureau of Mines

SELENIUM was in short supply throughout 1954 and no letup in demand nor substantial increase in supply is foreseen in the near future.

Electrolytic refining of copper produces an anode slime that is the principal source of selenium and the decline in copper production in 1954 caused a corresponding decrease in selenium production. This decrease was offset by increased recovery of secondary selenium and a large increase in U.S. imports. U.S. exports were subject to rigid Government control and totaled less than 25,000 lb.

Major producers of selenium are the American Smelting & Refining Co., American Metal Co., Kennecott Copper Corp., and International Smelting & Refining Corp. During 1954, Kennecott Copper Corp. changed over from commercial-grade to high-purity production. American Smelting & Refining Co., Kawecki Chemical Co., and Vickers Electric Division, Vickers, Inc., also were producers.

Selenium Statistics

	1953	Estimated 1954
Primary production, lb	923,887	825,000
Secondary production lb	97,948	125,000
United States imports, lb	99,865	175,000
Average price per lb, commercial grade	$4.25	$5.00

U.S. imports during 1954 were principally from Canada, but small quantities were also obtained from Mexico, Japan, Australia and Peru.

Adequate supply of selenium was not available to meet increasing demand during 1954. Selenium-rectifier manufacturers, who had consumed about 45% in 1953, consumed 50% or more of selenium production in 1954. This upward trend may be reversed in 1955 by development of germanium, silicon, and titanium dioxide rectifiers.

Glass manufacturers were unable to obtain enough selenium to decolorize all of their products or to produce all the selenium ruby glass they might have. Selenium is also used in manufacturing stainless steel, rubber, pigments, and pharmaceuticals and in a multitude of chemical applications.

Research was directed toward developing new sources of selenium and developing substitutes wherever possible. The U.S. Bureau of Mines is investigating the possibility of producing selenium from Lysite, Wyo. tuff deposits and the Idaho-Wyoming vanadiferous black shales.

Outlook for 1955 is one of continuing selenium shortage. Industry may be able to utilize some substitutes this year. Commercial exploitation of the seleniferous tuffs and shales may be decided upon in 1955, but even so, production could not begin for another year or two. A 10% to 20% price increase is a possibility•

Sulphur Production in U. S.

Long tons

Form of sulphur	1953	Estimated 1954
Frasch sulphur	5,155,000	5,500,000
Other elemental	375,000	400,000
Sulphur in pyrites	380,000	400,000
Sulphur in gases	333,000	350,000
Total	6,243,000	6,650,000

U. S. Frasch Sulphur Mines

MINE	COMPANY
TEXAS	
Boling	Texas Gulf Sulphur Co.
Clemens	Jefferson Lake Sulphur Co.
Damon	Standard Sulphur Co.
Hoskins	Freeport Sulphur Co.
Long Point	Jefferson Lake Sulphur Co.
Moss Bluff	Texas Gulf Sulphur Co.
Nash	Freeport Sulphur Co.
Orchard	Duval Sulphur & Potash Co.
Spindletop	Texas Gulf Sulphur Co.
LOUISIANA	
Bay Ste. Elaine	Freeport Sulphur Co.
Garden Island Bay	Freeport Sulphur Co.
Grande Ecaille	Freeport Sulphur Co.
Starks	Jefferson Lake Sulphur Co.

SULPHUR

Langbourne M. Williams
Freeport Sulphur Co.

THE U. S. SULPHUR INDUSTRY in 1954 increased its production of this widely used raw material to an all-time high.

U. S. production on the basis of preliminary data, is estimated at 6,650,000 long tons in all forms; about 400,000 tons more than in 1953. Sulphur from salt dome deposits mined by the Frasch hot-water process accounted for about 350,000 tons of the gain. Sulphur recovered from sour natural gas and petroleum refinery gases, the sulphur content of pyrites, and sulphur in various forms obtained from other sources accounted for the remainder.

A substantial part of the total supply came from Boling dome in Texas, the largest producer. The second and third largest producers were Grande Ecaille and Garden Island Bay in the marshlands of Louisiana. Garden Island Bay, which began producing late in 1953, produced in excess of 500,000 tons in its first full year. In all, 13 Gulf Coast mines were in operation, including Nash dome, completed in February.

The number of enterprises to obtain sulphur from other sources also rose. Among those completed during the year were projects of Columbia Carbon Co. at Seminole, Texas, and Phillips Chemical Co. at Eunice, N. M., for the recovery of sulphur from sour natural gas; of Anaconda Copper Mining Co. to expand pyrites output at Anaconda, Mont.; and of Eagle-Picher Mining and Smelting Co. at Galena, Kans., and Bunker Hill and Sullivan Mining Co. at Kellogg, Idaho, to utilize smelter gases.

Domestic consumption of sulphur continued to be high, paralleling general business activity. The use pattern by industries showed little change. About 80% of the sulphur consumed was converted into sulphuric acid, and the remainder used in elemental form or in other chemical compounds. Fertilizer accounted for about 33%; chemicals, 18½%; titanium and other pigments, 7½%; pulp, 7½%; iron and steel, 7%; ground and refined sulphur uses, 5%; rayon and film, 4½%; carbon bisulphide, 4½%; petroleum, 3%; and other chemicals and miscellaneous, 9½%.

Demand for U. S. brimstone from abroad was exceptionally high. On the basis of figures for the first ten months, it is estimated that exports for the year approximated 1,600,000 tons, compared with 1,242,000 tons in the previous year. The United Kingdom and Canada received the largest amounts while other major recipients included, in order of tonnage, France, Australia, New Zealand, Brazil, the Union of South Africa and Belgium.

Sulphur developments of importance elsewhere in the Free World: The start of production by the Frasch process in Mexico marked the first use of the process outside of the U. S. Mexican Gulf Sulphur Co. began production at San Cristobal dome in March, and Pan American Sulphur Co. at Jaltipan in September. In addition Gulf Sulphur Corp. announced plans to build a Frasch process mining plant at Salinas dome. All are on the Isthmus of Tehuantepec.

In Canada, Noranda Mines, Ltd. placed in operation a project using pyrites at Welland, Ontario, and Sherritt Gordon Mines, Ltd. began recovery of the sulphur content of smelter gas at Fort Saskatchewan, Alberta. In other countries projects included: Shell Oil Co., Ltd., Stanlow, England, refinery gases; Standard Oil Co., Aruba, N.W.I., refinery gases; and British Petroleum Co., Ltd., Grange Mouth, Scotland, refinery gases.

In Italy, the sulphur industry faced a crisis as a result of high production costs. The high costs, and correspondingly high prices, made export sales extremely difficult. Consequently a large part of the sulphur produced had to be stockpiled. Temporary financial assistance from the government had to be provided in order to prevent closing of the mines.

Outlook: As the year 1955 begins, efforts to increase sulphur productive capacity continue. Among the U.S. projects scheduled for completion are a Frasch process mine at Chacahoula dome in Louisiana and several projects to obtain sulphur in various forms from other sources. Sulphur consumers in the U.S. and all over the world can look with confidence in the new year to the prospect of ample supplies of this essential raw material•

PHOSPHATE

H. F. Dengler
International Minerals & Chemical Corp.

PHOSPHATE PRODUCTION in the U. S. A. reached an estimated 13-million tons in 1954 as compared to 12.5-million tons in 1953. Probably all three mining districts, Florida, Tennessee and Western Fields, will have participated in the increase.

Domestic consumption and exports should have held up with production although a silght increase in stockpiles is possible.

If available statistics for the first half of 1954 are duplicated in the second half, world shipments of phosphate rock should have reached record levels with a total of close to 27-million tons as against 25.4-million tons in 1953. Main supply areas are the U. S., North Africa, U.S.S.R., Pacific Islands and Egypt.

Western Phosphate Field

Based on a growing local industrial and agricultural phosphorus industry, the mining of phosphate deposits in Idaho, Wyoming, Utah and Montana continued at an accelerated pace. Over 60% of the phosphate produced is electric furnace charge. The balance is used for the manufacture of single and triple superphosphate, for direct application to the soil, and some 300,000 tons are exported into Canada. Most of the phosphate is mined by surface methods, particularly the lower grade shale for furnaces, whereas the higher fertilizer grades come mostly from underground operations.

During 1954 the following new developments occurred:

Anaconda Copper Mining Co. continued mining at Conda, 6 mi north of Soda Springs, Idaho, largely underground but some on the surface. The ore from this operation is shipped to a company plant at Anaconda, Montana and made into triple superphosphate.

San Francisco Chemical Co. is active in various sections of the field: At the Waterloo mine at Montpelier, Idaho, underground development was stopped but surface mining continued. In a new location some 12 mi south of Montpelier they were driving a long crosscut in the mountain range for the purpose of intersecting the ore at depth. They continued several shaft sinking and drifting operations at their Randolph, Utah mine where output is still on a limited scale. SFCC's main activities are centered in the open pit mine near Sage Junction in southwestern Wyoming. The phosphate is of a sufficiently high P_2O_5 content to be shipped to Stauffer Chemical Co.'s superphosphate plants in California and Washington. They are now also supplying the new triple superphosphate plant of Western Phosphates, Inc. at Garfield, Utah, a combined venture of Stauffer Chemical Co., American Smelting and Refining Co. and Kennecott Copper Corp.

Phosphate Production in the U.S.

Thousands of long tons	1953	Estimated 1954
Florida	9,331	9,500
Tennessee	1,519	1,600
Western Field	1,654	1,900
	12,504	13,000

J. R. Simplot Co., with offices in Boise, Idaho are the largest miners in the Western Field. They operate the open pit Gay Mine on the Fort Hall Indian Reservation, and large quantities of low grade shale (testing about 24% P_2O_5) were supplied to the four electric furnaces of Westvaco Chemical Division of Food Machinery & Chemical Corp. at Pocatello, Idaho. The higher grade rock was utilized in Simplot's own triple super plant at Pocatello. Simplot also conducted surface mining operations in the Crawford Mountains of northern Utah near Randolph, and, to maintain their leading position, they acquired phosphate holdings on the Idaho-Montana line and carried out prospecting work on this property.

Monsanto Chemical Co. installed a second electric furnace at their Soda Springs, Idaho plant and obtained the phosphate from their own open-pit mining operation 16 mi north of Soda Springs.

Victor Chemical Works with a two-furnace operation at Silver Bow, Mont., obtained their rock from their underground mines in the Maiden Rock area, some 30 mi south of Silver Bow.

Montana Phosphate Products Co., a subsidiary of Consolidated Mining & Smelting Company of Trail, B.C., continued mining and shipping the entire output to Trail, Canada.

Western Fertilizer Association, a group of farm co-ops with holdings in Dry Valley near Soda Springs, and Central Farmers Fertilizer Co., with holdings in Georgetown Canyon in the same vicinity, were active with exploratory and sampling work in anticipation of full scale mining.

All this adds up to an output of close to 2-million tons with optimism high for 1955 and beyond.

Florida

The Florida phosphate mines operated at near capacity and should have produced about 9.5-million tons, which would set a record. Probably sales and shipments stayed a little behind with the result that stockpiles might have been increased somewhat. The entire production, with the exception of some 80,000 tons each of so-called soft-and-hard rock, was Florida land pebble phosphate.

On the technical side the various mining companies report the following:

American Agricultural Chemical Co. placed in operation a new 650-B dragline; improved drying facilities resulting in greater drying capacity; purchased approximately 4,000 acres of phosphate land and increased the capacity of their washer and recovery operations.

American Cyanamid Co. states that while their operations continued at a normal annual rate, there was no major expansion or extraordinary capital investment for plant facilities in 1954.

Armour Fertilizer Works are in the process of developing a new mine which is proceeding satisfactorily and are now erecting a Bucyrus-Erie 770-B dragline.

Coronet Phosphate Co.—Division of Smith-Douglass Co., Inc., did not report any new developments in their operations.

Davison Chemical Co. commenced

installation of a portable belt conveyor system for removal of overburden from their Bonny Lake Mine. The main conveyor will be 1200 ft long and will be fed by two lateral conveyors consisting of one or two 100-ft conveyor sections. Each of the lateral sections will be fed from a 20-ft square hopper with a reciprocating feeder over the belt. Each hopper will be fed by a Bucyrus-Erie 54-B dragline carrying a 70-ft boom and 3½-yd bucket.

Near Bartow, Fla. their new triple superphosphate plant was brought on stream with an annual capacity of 20,000 tons.

During 1954 the name of this company was changed to Davison Chemical Company Division of W. R. Grace & Co.

International Minerals & Chemical Corp. placed in operation the largest dragline in the field, a Bucyrus-Erie No. 1250-B, carrying a 235-ft boom and 26-yd bucket; increased feed capacity at Peace Valley by installing a new feed classifier and storage bins; installed automatic controls on matrix and clear water pumps; designed and installed a new dragline cab on a 650-B dragline to achieve maximum production and operator comfort; and increased washer capacity at the Achan Mine by some 25%.

At their Bonnie Chemical Plant this company added a section and commenced production of triple super.

Swift & Co. installed improved type hydraulic mining guns, increasing production and decreasing man power. A project has been set up to neutralize all effluent from operations seeking its way into public waters.

Virginia-Carolina Chemical Corp. started the operation of new handling facilities, wet storage, drying and grinding units at Nichols, Fla. Their performance meets or exceeds original design expectations. The traveling double wing stacker used for placing the various grades of wet phosphate rock on storage is unique in the phosphate field. The reclamation of wet rock is effected by the use of two parallel conveyors located in tunnels under the two parallel piles of wet rock formed by the stacker. Experience gained in the use of a 5-mi pipe line for transporting matrix has been useful at other locations and permits maximum operating flexibility.

Low grade washer rock heretofore unmarketable can now be beneficiated by means of facilities incorporated in the washer flowsheet. VC's new concentrated superphosphate plant at Nichols, Fla., together with the uranium extraction unit, were taken into operation.

Tennessee

In spite of temporary interruptions due to lack of power caused by low water levels, phosphate production in the Tennessee Field continued at about the same rate as in previous years, an estimated 1.6-million tons. Most of this had a BPL content of less than 60% used in electric furnaces for conversion into elemental phosphorus. The balance is ground and sold for direct application to the soil, and only about 10% was used in the manufacture of single and triple superphosphate. This is the now established pattern of mining and distribution and will be repeated in 1955 and beyond. New developments include the following:

M. C. Boyle Phosphate Co., after completing their drying and grinding plant, proceeded with the construction of a phosphate washing plant in the vicinity of Anderson Bend, a few miles west of the Duck River community in Hickman County.

Owens Phosphate Co., who also operate a small drying and grinding plant immediately south of Centerville, completed construction of a small phosphate washer on Swan Creek, some 8 mi from Centerville.

Mine Equipment Co. completed a crushing, screening and scrubbing plant for the processing of gray rock, a phosphatic material of reasonably high phosphorus content. This gray rock is mined from deposits west of Columbia and hauled by truck a distance of 10 to 20 mi to the plant site on Rutherford Creek. The output is used as furnace burden for the production of yellow phosphorus.

TVA continued its phosphate activities in 1954 and reports the following:

The TVA phosphate washing plant near Columbia, Tenn., remained inactive during the year. Raw phosphate matrix was shipped to the chemical plant at Wilson Dam, where it was blended with Florida pebble to make a suitable electric furnace charge. Mining operations were continued in the Bear Creek and the Knob Creek areas.

Two fused tricalcium phosphate furnaces at Columbia were operated during the first half of the year. Both furnaces, one of which has a graphite hearth and the other a copper hearth, satisfactorily resisted corrosion by molten rock phosphate and furnace gases. With a solution of the problem of furnace corrosion, the technical development of the fused tricalcium phosphate process was successfully completed.

Both the washing plant and the fused tricalcium phosphate plant, with land, buildings, and accessory equipment, are being offered for public sale.

At Wilson Dam, Ala., a unit for briquetting blended Tennessee matrix and Florida pebble was installed and put into operation. The briquets are calcined in either a rotary kiln or a shaft kiln for use as charge to the electric phosphorus furnaces. Electrostatic precipitators were installed for recovering dust from the escaping stack gases of the phosphate nodulizing kilns.

Slag from two of TVA's electric furnaces is expanded to make light aggregate in equipment installed during the summer. The material is used by concrete block manufacturers to make lightweight blocks for building purposes.

Calcium metaphosphate fertilizer production was increased from 5,000 to 6,000 tons per month by further improvements in equipment and operation. A limestone-packed tower system to remove fluorine from offgases of the metaphosphate unit was completed and put into operation.

Pilot-plant studies were continued on a process for producing fertilizer from Florida leached zone phosphate, and further studies were made of methods of beneficiating the leached zone ore. Research also was continued on the development of several other promising phosphate fertilizer processes, including methods for producing high-analysis granular fertilizers.*

Worldwide phosphate demand in 1954 was at an unprecedented high. While consumption in the U.S. within narrow margin was the same as in 1953, other areas, particularly Europe, showed a considerable advance. This benefited especially the North African mines, although the Florida Field should at least have maintained the 1953 exports of approximately 1.8-million tons.

Outlook: All indications are that the high levels of activity in the phosphate mining and consuming industries will continue and even grow in 1955•

*Supplied by Dr. J. H. Walthall, director, division of chemical development, Tennessee Valley Authority, Wilson Dam, Ala.

ASBESTOS

Walter A. Rukeyser
New York, N. Y.

1954 WILL BE MARKED as a milestone in the history of asbestos production. Two outstanding facts fully justify this statement. First, the 10-month Canadian statistics show that the industry has passed through a transition from the tight-supply, sellers' market of the past decade to one of abundant supply. Second, plans for relatively large-scale new production have been consummated by some companies and initiated by others. In fact, Canadian developments for the year seem so far to outstrip those of the rest of the world as to warrant a thorough analysis of their probable world-wide impact.

Prophecies for the industry made last February seem to have been fulfilled. To begin with, the slump in sales of all grades which began in August 1953 continued until Autumn 1954. The sole exception, as also forecast, comprised Group 7 shorts which ran counter to the general trend and actually increased in sales volume due to ever-expanding demand of the floor-tile trade. In fact, by October 1954, shipments of all classes of Canadian fiber had increased to a point where, if sustained at the same rate until year's end, they will have equaled the tonnage and dollar-value of 1953. The figures, however, do not speak for themselves; their significance must be arrived at in terms of a presumably ever-expanding national economy. Next, sales of Russian asbestos have been increasing to many markets where its entry might not be prohibited by government policy. Lastly, construction of important new production facilities, which had been either started or projected previous to 1954, was in no way affected by the year's much-heralded recession.

Canadian published prices have not changed since January 1952. Therefore average price for each grade as realized for 1953 has been used to evaluate 1954 10-month production in the accompanying table.

Another table is presented here to show the relationship between value and tonnage of Canadian shipments and U. S. gross national product.

Value of Canadian Asbestos Shipments

Grade	Av. per ton	10-Mo. 1954 shipments
Crudes 1, 2, etc.	$1000.	$ 500,000
Group 3	370.	9,250,000
Group 4	170.	22,865,000
Group 5	115.	9,396,000
Group 6	75.	10,583,000
Group 7	40.	13,212,000
Group 8S	19.	526,000
10-month total:		
Quebec		$66,332,000
Canada		68,850,000
1954 estimated total – Canada		$86,000,000

These figures are provocative in view of the tremendous 1954 Canadian expansion program. Above all note that the sale of shorts has more than kept pace with the gross national product. But these grades represent the lowest dollar-value, the groups averaging less than $50 per ton at today's prices. In 1953 they accounted for $29- of a total of $86-millions. In tonnage, however, they accounted for nearly two-thirds of the total. On the other hand, the Groups 1-5 crudes and fibers, constituting a third of the tonnage but yielding two-thirds of the value (averaging some $175 per ton), have not even remotely kept astride the growth of the overall economy. Taking 1938 as 100, their sales by 1948 had reached an index of 150 as compared to that for the national output of 250; in 1953 they had merely doubled to 200, whereas gross product was quadrupled to 400; and, in 1954, their index factor appears actually to have fallen off to say, about 180 as compared to a fall in U. S. output amounting to but some 3%.

Asbestos production reached peaks both in tonnage and dollar value in 1951 and 1952—not in 1953. Therefore, if the national gross product reaches the $500-billion mark predicted for 1965 by many economists, this one-third increase over the present would *not* seem to imply a similar increment in the use of the Groups 1-5 fibers. For actually, from 1938 through 1953, the rate of increase in the utilization of those grades was only 50% that of national gross product. On the other hand, even if the sales of crudes, spinning and shingle grades did keep abreast of the growth of national output, it appears from the accompanying tables that an additional 100,000-ton production of Canadian chrysotile might well saturate the normally anticipated increase in demand. However, new plants, either completed or already commenced in 1954 in Canada alone, will have an ability to satisfy such increase (as postulated for 1965) two-fold. Thus, in the next decade the rate of increase of utilization of the longer fiber asbestos must reverse its trend of the past quarter century four times over, if the apparent available supply is to be absorbed by the market. However, such reasoning does not take into consideration the fact that inadequate supply of these grades, due to the inability of the ore to produce more 3, 4 and 5 from previous mill capacity, was perhaps an important factor.

Canada produced 937,851 tons of all grades of crudes and fibers in 1952, a banner year. In 1954 the potential was still greater. This production came from mill capacity almost wholly available since before the last World War. The exceptions were the new Flintkote (1946) plant of then 750 tpd rock capacity near Thetford; the more recent expansion and modernization of the old British-Canadian unit of Asbestos Corp. at Black Lake to 6,000 tpd (1952) and the erection of the new Johns-Manville 2400-tpd mill (1950) in northern Ontario. This 1952 production was derived from 13-million tons ore mined and 11-millions milled. The available mill capacity totaled approximately 40,000 tpd. The resulting 361,894 tons of Groups 1-5 asbestos represented a little less than 3½% of the rock milled. Let us now examine the potential as implied by the past year's developments.

Johnson's Asbestos Co. started production at its new plant at Black Lake last year. Though rated at 4,000 tons per day it is said to be capable of at least 5,000. The official opening was in July when output from the obsolete 700-tpd Black Lake mill was terminated. Affecting the longer-fiber markets with great impact, production from this new mill will fall mainly in Groups 3-5, the average value per ton of fiber being substantially higher than that for the district as a whole although the percentage extraction, due to lesser quantities of shorts, will be somewhat lower. Ore reserves de-

veloped to date exceed 25-million tons.

This mill reputedly utilizes the attrition action of a series of gyratory or cone crushers to liberate the fibers of each group excepting shorts which are produced by air-swept ball mills. Jumbos have been eliminated almost entirely from the flowsheet. It is the writer's guess that this plant, when permitted to operate maximum time at full capacity is able to produce an increment of some 40,000 tons annually of spinning, shingle and paper stocks.

Cassiar Asbestos company's new 500-tpd unit in the McDame Lake area of northern British Columbia also went into full-scale operation in 1954. By October it was treating 700 tpd and "without major expenditure" could treat 1,000. Ore reserves now stand at almost 7.5-million having place value of better than $30 per ton in but two grades, 3-K and 4-K, not including substantial amounts of crude. The experimental mill, which treated nearly 90,000 tons, established grade at nearly 12%. Although open-pit mining will be seasonal, due to the rugged factors of climate and topography, the mill will be operated at its nominal rate throughout the entire year. The fibers from this deposit, limits of which have not as yet been delineated, are of superlative quality and a production of about 20,000 tons per year of 3-K and 4-K should result from this operation.

Johns-Manville opened the first half of their new mill building at Asbestos, Que., on Oct. 1. One-quarter of the ultimate equipment has been installed and is now operating. The full plant capacity, upon its completion in the spring of 1956, will be 625,000 tons of all grades of fiber per year. This is equal to two-thirds of the total Canadian output for 1954 and better than half that of the present Free World! Since J-M has always been a major producer of shorts, which has boosted its percentage yield, the writer calculates the rock capacity of the new mill when completed as some 16,000 tpd. The present obsolescent mill, producing slightly better than 500,000 tons of fiber annually, is still in production and apparently will not be scrapped until the new, highly efficient units are in full operation. So it would appear that the combined present potential now exceeds 650,000 tons per year. Of this some 150,000 tons are new and, using for an estimate the average proportion of each grade produced by the district as a whole, there should be an increment of about 50,000 tons annually of Groups 3-5.

(*Please turn to p 112*)

Canadian Chrysotile Asbestos Shipments

10-month period, short tons

	1952	1953	1954
Quebec			
Crudes	617	601	500
Spinning, shingle and paper	274,280	251,263	241,614
Shorts, etc.	487,585	487,657	499,180
Total	762,482	739,521	741,294
Canada	781,581	762,862	765,217

Canadian Asbestos Shipments by Grades

(Including any for own use.)

	October		Year to date	
	1953	1954	1953	1954
Quebec				
Crude – No. 1, No. 2, Other	55	42	601	500
Milled – Group 3 (spinning)	2,726	3,095	28,055	24,943
Group 4 (shingle)	15,169	15,453	136,911	134,472
Group 5 (paper)	7,609	9,123	86,297	81,699
Group 6 (stucco)	12,876	16,315	148,286	141,098
Group 7 (refuse)	36,341	38,045	313,518	330,336
Group 8 (sand)	2,802	2,930	25,853	27,746
Total all grades	77,578	85,003	739,521	740,794
Canada	80,713	88,394	762,862	765,217

Canadian Asbestos Exports

	October		Year to date	
	1953	1954	1953	1954
Crude	139	50	511	486
Milled fibers	27,937	31,174	260,741	249,566
Waste, refuse, shorts	49,277	53,417	464,619	471,634
Total	77,353	84,641	725,871	721,686

Prepared in the Mineral Statistics Section, Industry and Merchandising Division, Dominion of Canada Bureau of Statistics.

Canadian Shipments Compared With U.S. Gross National Product

12-month period, short tons

	1938	1948	1952	1953	1954 (est'd)
Crudes	2,911	977	741	781	600
Spinning, shingle, paper	163,097	241,953	352,385	327,121	295,000
Shorts, etc.	123,785	473,839	576,954	584,105	615,000
Total all grades Shipped	289,793	716,769	929,339*	911,226*	910,600
Produced	–	–	937,851	920,191	–
Value (shipped)	$12,890,195	$42,231,475	$89,254,913	$86,052,895	$86,000,000
Av. fiber pt.	$44.40	$58.90	$97.10	$94.40	$94

*Revised

	1938	1948	1953	1954 (est'd)
U.S. gross product (billions)	$90	$225	$365	$353
1938 = 100				
U.S. product	100	250	400+	400—
Spinning, shingle, paper	100	150—	200—	180
Shorts, etc.	100	380+	470+	500—

At J-M's Munro, Ont., mine the company is now preparing for underground mining; but it will take about four years before the switch-over from open-cut is completed. The main shaft is being sunk to a depth of 800 ft with haulageways to be turned off at the 740-level. The mill continues to operate at a rate of 100 tph.

Asbestos Corp.'s new Normandie mill is scheduled for (early 1955) production. It will beneficiate ore from its new mine at Vimy Ridge, Que. Rated at 5,000 tpd, on an orebody boasting a reserve of 35-million tons already developed and from which 5-million cu yd of overburden have been removed, this plant incorporates many departures from previous asbestos-mill design. Primary among these is the installation of six 17½-ft x 5-ft Aerofall mills which complete in one stage practically all ore comminution following previous jaw and cone crushing and drying.

The ore from this section of the Thetford-Black Lake district has always yielded a relatively high percentage of premium quality shingle fibers. The guess is that at least 40,000 tons per year of the longer grades should be produced by this new unit.

American Smelting & Refining Co.'s completely owned subsidiary, Lake Asbestos of Quebec, has finalized its commitment to erect a mill of at least 4,000 tpd on the properties of the vendor company, United Asbestos, at and underlying Black Lake itself. During the year just past, Lake Asbestos has taken title to the ground and formalized all necessary by-agreements covering such items as mutual boundary lines, road removal, drainage of Black Lake with its concomitant diversion of the Belancour River, dam construction—in fact has completed all legal and engineering matters preparatory to the start of the $20-million project.

All of the above new production, excepting that only of J-M, concerns companies not allied with manufacturing affiliates, although it is true that Turner-Newall and Raybestos-Manhattan own a substantial share interest in Cassiar. However, in the case of J-M, considerably less than half the fiber output goes to its own plants, the balance is offered on the open market by its Fiber Sales division. Most of those companies whose mines are captive, such as Flintkote, Philip Carey (Quebec Asbestos) and Nicolet in Quebec, excepting Ruberoid in Vermont (its 2,400 tpd modern new mill was completed some three years ago) are likewise planning increased output. National Gypsum, who entered the asbestos industry in 1953 by the purchase of the Asbestone Co.'s fabricating plants in New Orleans and St. Louis along with that of the Smith Asbestos Co. at Millington, N. J., likewise seems interested in producing its own fiber since it has acquired a mortgage on the property and newly constructed mill of Dominion Asbestos. The Dominion mill was put into production last August on a comparatively low-grade orebody near St. Adrien de Ham, Que. It is a modern plant having capacity of 100 tph. The mill operated for only about three months, however, when the company was obliged to suspend operations, the ouput having been mainly in Group 5 and shorter grades.

Flintkote's operation on the Pennigton dike has now reached an operating rate of 1500 tpd. The mine is now nearly half a mile long over an average 200-ft width and 80-ft depth. Althought the open-pit life expectancy at the time the mine was acquired was not great in terms of the major orebodies of the district, the mill has been operating steadily since mid-1946 and it now appears that two-thirds of the total ore available by open-cut at its inception is still in reserve for the future.

Quebec Asbestos, in 1954, had developed a large, entirely new deposit which is not only important in itself, but apparently has extended the concept of the northeasterly extension of the productive zone of the Pennington Dike. The new orebody, or rather series of orebodies, some 3 mi NE of East Broughton, occurs in a 3-mi zone and to date upwards of 40-million tons have been developed by last summer's diamond-drilling and trenching. A new plant is proposed with a minimum capacity of 2,000 tpd. The character of this ore was demonstrated by a several thousand ton mill-test, and while this is said not to be representative of the orebodies as a whole, yielded better than 25% of shorts resulting in a place-value of between $10 and $12 per ton. However, considerable quantities of higher grade material will be produced from the operation when it gets under way.

The main Thetford orebody, some 2200 ft x 1300 ft lies directly alongside, and its extensions directly under, a sizable portion of the town of Thetford Mines. It had been mined to an average depth of some 300 ft by the connecting open-pits of the Asbestos Corp. (The King Mine), The Johnson's Co. (Thetford Mine) and Bell Asbestos. All three companies are now mining this deposit entirely by block-caving. Resulting subsidence threatens the loss of large blocks of ore. To avoid such loss the three companies jointly have formed Relocations, Ltd., which is now engaged on a $5.5-million project of relocating all buildings, streets, highways, railroads—that may lie within the affected areas. Relocation of 8½ mi of Quebec Central mainline three miles west of the town was completed in 1954.

A labor dispute which had been undergoing arbitration attempts since January 1954 was finally resolved in December to the satisfaction of the men as well as the three companies involved, Asbestos Corp., Johnson's and Flintkote. Wages were brought in line with those already established by the other companies who had granted a raise of 2c per hour at the first of last year with an escalator clause of 2c per hour tied to the cost of living. On Jan. 1 of this year an additional 1c per hour was included in the package so that wages have increased some 5c since 1953 to an average hourly rate of about $1.67 for the district. This does not include extensions of fringe benefits to the working force.

Production costs should not be greatly affected, however, since the percentage wage-increase is small and the price of some commodities entering into the cost of finished fiber have declined slightly.

J-M's new discovery of crocidolite in New Quebec is significant. A working arrangement has been concluded with Hollinger North Shore Exploration Co. for prospecting on the latter's 3700 sq mi property.

Small independents in these two countries were naturally affected adversely by the 1954 recession. Prices were dropped to a more competitive basis with Canadian crudes and fibers. Dr. Oliver Bowles, Commodity Specialist of the U. S. Department of the Interior in personal correspondence with the writer, states that imports in the first 9-months of 1954 into the U. S. were 5,115 short tons from Southern Rhodesia and 19,283 from Union of South Africa. This compares with 7,013 and 24,461 for the same period in the previous year respectively.

A new producer was brought in Southern Rhodesia in 1954 by Rhodesian Asbestos Ltd., a company in which J-M owns a 51% share interest and in which Anglo-Huronian is a partner.

Autumn 1954 saw an upswing in Canadian asbestos shipments, between 60 and 70% of which normally go to

the U. S., and the volume of these was such that the final three months' sales may well have exceeded the same period of any previous year. With U. S. home and industrial construction showing every evidence of maintaining peak proportions throughout 1955; with automobile production again at pre-recession levels; with home modernization and maintenance at a new high (probably due to large extent to the "do-it-yourself" craze which has swept the U. S.), the outlook for banner sales of asbestos in the coming year is bright.

For the longer range, the situation may become highly competitive with the major portion of the spoils going to the most efficient mines, the richest or the best integrated. For, by late 1956 or early 1957, there should be available a new Canadian supply of something just under 200,000 tons per yr of Groups 3-5 fibers, affording a gross potential of about 550,000 tons per yr of these grades alone. The additional mill-capacity of some 20,000 tons of rock per day will create a total of over 60,000. It will produce, in addition to the above, an increment of at least 225,000 tons per yr of shorts. Hence the total Canadian annual output should attain a rate of 1.4-million tons.

Since the major portion of Canada's production (nearly 70%) has always gone into the U. S. market, the ability of Canada to sell this production depends largely on the state of the American economy. The expanding U. S. national gross output seems to indicate the ability to absorb at least the shorts output by 1965 (U. S. takes practically all of these grades not used by Canada itself). The facility with which the available 550,000 tons of longer fibers can be sold appears, at this time at least, to be less certain•

VERMICULITE

Walter S. Steele
American Vermiculite Corp.

VERMICULITE made further gains in 1954 and strengthened its productive foundations in both the U.S. and South Africa.

American mines in Montana and the Carolinas made gains aggregating slightly over 10% while South African imports in 1954 were more than double in 1953, with total volume for the year from both sources in excess of 225,000 short tons. Tonnage figures do not tell the complete story, however, because vermiculite is marketed by volume rather than weight. Densities vary from 3 lb to 10 lb per cu ft. Estimated 1954 tonnage, therefore, was approximately 76-million cu ft of exfoliated vermiculite.

Crude ore prices were virtually unchanged in 1954, ranging, according to grade, from $9.50 to $14.50 (f.o.b. mine) per short ton for domestic ores; and from $27.00 to $34.00 per ton (c.i.f. U.S. Ports) for South African crude ore.

Prices on exfoliated materials were also steady in most parts of the country, dealer prices ranging from $0.90 to $1.30 per four-cu ft bag, depending upon quantity and screen analysis or grade.

Zonolite Co., operating mines in Montana and the Carolinas, completed a major processing changeover designed to increase its ore recovery and improve its grades of crude ore materially.

Transvaal Ore Company, Ltd. late in 1953, completed its acquisition of the adjacent mines of Vermiculite (Pty.), Ltd. and Palabora Phosphate & Vermiculite (Pty.) Ltd. in the Palabora district of the Northern Transvaal, becoming the sole producing exporter of vermiculite ore in the Union of South Africa. This consolidation, development of a long range mining program and completion of its new and enlarged processing plant at Loole' Kop in November 1954 now insures a trebled output of crude vermiculite ore in 1955 from the world's largest and purest known deposits.

Foreign offerings of crude ore from Japan, Argentina, India, Kenya and Southern Rhodesia in 1954 indicate an increased interest in vermiculite production in those fields, with substantial quantities offered for export. Test lots checked by Vermiculite Association members indicate that to date none of these operations have developed competitive qualities for the American market.

There are now approximately 50 commercial vermiculite exfoliating plants with 10 or 12 additional furnaces operated by consuming plants which utilize the exfoliated material in their own products.

Principal uses for exfoliated vermiculite in 1954 were: home insulation, concrete and plaster aggregate, horticultural, precast and premixed vermiculite slabs, plank, blocks, fired and unfired refractories, various cements and plasters.

Use of plaster gun equipment, predominant in the West and rapidly spreading across the country, has given a tremendous impetus to vermiculite plaster which is non-abrasive in character and adapts itself particularly to machine application.

Vermiculite acoustical plastic applied both manually and by gun; precase acoustical tile; concrete roof tile; fireproof bedding for race horses; have been developed and are increasing in volume.

Vermiculite as a carrier of pesticides, as a fertilizer conditioner, as a packing material for electrolytes and as a light weight, inert filler and absorbent showed satisfactory gains during 1954. Vermiculite concrete insulation for underground pipelines also continued in steady demand throughout the year.

Forecast. There will be a continued steady growth in the use of vermiculite during 1955. Growth should continue indefinitely because of the versatility of the material and the wide range of uses being developed for vermiculite products.

Interests of the vermiculite industry are advanced by two non-profit membership groups: Vermiculite Institute of Chicago, Ill., whose members are all operating primarily with domestic ores; and Vermiculite Association, Inc., of New York, with an international membership unlimited as to crude ore sources but chiefly users of South African crude.

The vermiculite technical associations have heavy research and test programs underway in 1955. Producing mines in the U.S. and South Africa are prepared for sharply increased demand and existing exfoliating plants (with 10 additional operations anticipated in 1955) have sufficient capacity and are so situated that vermiculite is economically available in all parts of the country•

BARITE

Reginald Rowand
National Lead Co.

HIGHLIGHTS among the new developments in the barite industry in the past year have been the increased importation of foreign ore, further expansion of domestic processing facilities, and development of more economical methods of bulk transportation of finished product to offshore oil well drilling sites.

Barite sold or used by domestic producers, exclusive of imported material, was 944,000 short tons in 1953. From all indications the 1954 production will be about the same. World production of barite is currently on the order of 2,100,000 tons, on an upward trend. The United States consumes 54% of world production.

Oil well drilling currently consumes about three-fourths of the domestic plant output. Barite provides weight for drilling fluid to counteract high pressures. A finely ground material of high specific gravity with good mud-making properties is required. About one-half of the demand by this industry is localized in the Gulf Coast area, with the balance fairly well spread over the central part of the U. S. and some further concentration in the southern part of California.

Chemical industry requires barite of high purity in which silica, iron, fluorite, lead and other impurities can be detrimental; specifications differ with intended use. Lithopone is being supplanted to some extent by more opaque titanium dioxide, thereby reducing the requirements of barite.

In ultrasonics there is some interest in the use of barium titanite and it is quite probable that a broader use for barium metal and alloys will develop in the electronics field. The various barium compounds have myriad uses in the beet sugar, rubber, paper and textile industries.

Output: Arkansas still leads in domestic output, closely followed by Missouri and Nevada. Georgia, Arizona, Montana, Tennessee, South Carolina and New Mexico are responsible for most of the remainder. In 1954, Arkansas shipped slightly less than the 380,700 tons of barite moved the previous year. A prolonged labor strike at one of the operations is responsible for the decrease. This barite is a relatively low grade ore mined by both open pit and underground methods. It is beneficiated by jigging and flotation. One operator is expanding its plant facilities. Most of the Arkansas product is for oil well use.

Missouri shipped 330,700 tons of barite in 1953, and it is estimated that the 1954 figure will show a slight increase. Missouri production is consumed by both the oil well drilling and the chemical industries. Nevada shipped 99,500 tons of barite in 1953 and probably will exceed this figure in 1954. Most of the ore mined in Nevada is shipped to California where it is processed and utilized in both the oil well drilling and chemical industries. Nevada production is dependent upon West Coast demand which has shown a strong upward trend in recent years, especially in the chemical field. Producers in Montana, Arizona, New Mexico and Georgia continue to supply localized markets.

Seven dry grinding plants on the Texas-Louisiana Gulf Coast, five of which have been built within the past three years, continue to supply a large portion of the Gulf Coast oil well drilling market. Most of the crude ore for these plants is imported from foreign sources.

Imports of crude barite ore into the United States have increased from 52,755 short tons in 1951 to 334,788 short tons in 1953. It is anticipated that the curve will level off. More than half comes from Nova Scotia; Yugoslavia and Mexico are next in importance. The amount of ground barite imported into the United States is insignificant. Since 1951, the import tariff has remained at $3.00 per ton on crude and $6.50 per long ton on ground material.

Rubberized barytes. Manufacture and marketing of a rubberized product for use as an additive to asphaltic road surfacing material in the construction of highways, parking areas, etc., is rapidly gaining acceptance.

Outstanding trend in the industry has been the increase in the importation of high grade crude ore, in spite of the high tariff. This is largely a matter of transportation cost rather than any shortage of domestic material. Known domestic reserves are very large on the basis of projected consumption. Many of the known deposits are not presently competitive but may become important as some active deposits are exhausted and as the market areas shift•

PERLITE

S. W. Johnson
Texas Lightweight Products Co.

PRODUCTION AND SALES continue to climb. Crude prices made substantial gains but expanded product remained about the same. Premixed perlite plaster and perlite concrete made good gains. Better marketing conditions and continued growth expected for the future.

Total sales of expanded perlite for 1954 according to a Perlite Institute estimate amount to 208,000 short tons or approximately 12,480,000 four-cu ft bags. This is an increase of 19.2% over 1953. Value of expanded product sold, if the trend of the past two years is maintained, is about 87c per four-cu ft bag totaling $10,857,600.00.

Crude perlite ore sold during 1954 is estimated at 230,000 short tons with a mine value of $7.75, a 15.8% increase on tonnage and 23.8% increase in value.

Per ton value of crude perlite ore rose again during 1954 while the average per ton value of expanded product is estimated to be about the same or a little lower than 1953. This indicates better competitive conditions in the crude market and a continued highly competitive expanded aggregate market. It is to be hoped that better market conditions will gradually develop for the expanded product and there is some indication the industry is now entering a more favorable phase.

Tonnage figures alone do not reveal the true magnitude of the perlite market, due to the extremely light weight of the expanded material. When it is "popped" in special furnaces, each ton

of the crude rock expands to about 10 times its original volume.

Prices within the industry were relatively stable in 1954, although there was some continuation of the trend toward higher prices for the crude rock and lower prices for the expanded product as both sales volume and competition increased.

Competition was especially keen in the plastering industry where perlite is challenging older, established aggregates. At the same time, competition within the industry increased as perlite aggregate for job-mixed plaster competed with mill-mixed perlite gypsum marketed by the gypsum industry. However, gypsum companies continued to purchase much of their expanded perlite from the independent perlite processors, although a few gypsum producers now have their own perlite popping plants.

Between 75% and 80% of total perlite production is now utilized in base-coat and acoustical plasters.

During 1954 perlite aggregate was used in approximately 40% of all basecoat plaster applied in this country, according to Perlite Institute estimates based on gypsum consumption reported by the U.S. Bureau of Mines.

However, it is in lightweight, insulating perlite concrete roof decks that the independent perlite processors see their future growth. Perlite aggregate combined with Portland cement creates an extremely light concrete which combines the functions of roof deck and roof insulation in one monolithic fireproof slab. This has led to its acceptance by many designers of industrial and school buildings, so that the volume of perlite used in roof construction is steadily increasing.

Also during 1954, Institute research showed that the permeability and moisture transmission characteristics of perlite concrete make it highly suitable for use as an insulating fill over metal roof decks. As a result, perlite concrete insulated metal decks have been approved for the application of bonded roofing by the major roofing manufacturers.

Outlook: Thus, better than 10% of perlite production goes into insulating concrete, and the outlook for continued growth of this market is excellent. Other uses, such as filter aid, soil conditioner, loose fill insulation, oil well concrete, paint additive, chicken litter and foundry uses make up the remaining 10% of the perlite market•

Perlite Statistics

Crude Perlite	1953*	Estimated 1954
Production (short tons)	213,532	340,000
Sales (short tons)	141,282	230,000
Value	$1,072,065	$ 1,782,500
Expanded by producer	57,469	95,000
Value	$ 367,593	$ 620,000
Expanded Perlite		
Production (short tons)	175,234	210,000
Sales (short tons)	174,461	208,000
Value	$7,997,731	$10,857,600

*U.S. Bureau of Mines report MMS No. 2329

FELDSPAR

Brooke L. Gunsallus
U. S. Bureau of Mines

SALIENT ACHIEVEMENTS in the feldspar industry in 1954 were: Completion of the first plant in the U.S. designed to produce high-potash-feldspar flotation concentrate; increase in the quantity of feldspar produced by flotation; and continued modernization of mining and plant facilities.

Flotation: Appalachian Minerals Co., Monticello, Ga., was purchased by North Carolina interests, and a modern flotation plant to recover high-potash feldspar from pegmatites was built—the first plant of its kind in the U.S. This plant will supply feldspar concentrates to the pottery and enamel industries, and to the glass trade.

Flotation of feldspathic ores is increasing, producing about 35% of all saleable feldspar in 1954.

Modernization and Development: Feldspar Flotation Corp. improved its process to enable production of low-iron content concentrates.

Feldspar Milling Co. completed mechanization of its mining operations and installed a modern grinding plant. This company dry-grinds hand-cobbed feldspar only. A 3-yr program of exploration and development for high-potash feldspar was completed.

Bell Minerals Co. completed the rehabilitation, started in 1953, of its mining and milling facilities. Two new feldspar mines were developed.

Production: Based on trends for 9 months, production of crude feldspar in 1954 was a little less than the 1953 output of 452,600 long tons, largest in the history of the industry. Production of ground feldspar followed the same pattern and declined a little from the 463,876 short tons produced in 1953.

Glass-container and pottery industries were estimated to show a slight decline and the flatglass and sanitaryware industries, a small increase in the consumption of feldspar. Enameling consumed about the same quantity as in 1953.

International Minerals & Chemical Corp. moved its feldspar-grinding plant from Rochester, N. Y., and consolidated all milling at Buckingham, Quebec, Canada, without decreasing production facilities.

Imports of crude feldspar in 1954 were negligible.

Nepheline Syenite: There has been a progressive increase in the imports and use of nepheline syenite from 1944 through 1954, with an increase in 1954 of 7% to about 95,000 short tons. If the present competitive position of nepheline syenite and feldspar remains about the same, maximum consumption of nepheline syenite for several years will probably not exceed 100,000 short tons per year.

International Minerals & Chemical Corp. plans to build a plant at Blue Mountain, Lakefield District, Ontario, Canada for processing nepheline syenite•

FLUORSPAR

John E. Holtzinger
U. S. Bureau of Mines

REVERSING THE TREND of recent years, the fluorspar industry sustained a major setback in 1954, with domestic output at the lowest level since 1949 and imports and consumption considerably below the record rates achieved in 1952 and 1953.

Prices, which had shown signs of weakening in the latter months of 1953, dropped abruptly after the spring of 1954. Depressed market conditions resulted in curtailment of operations at several domestic producing installations, and some mines and mills were shut down completely.

Metallurgical-Grade producers were the hardest hit segment of the industry, production dropping from 130,000 tons in 1953 to an estimated 45-50,000 tons in 1954. Imports of metallurgical-grade spar also declined. Consumption by the steel industry was expected to total about 200,000 short tons compared with 288,000 tons in 1953, and stocks at steel plants were sharply reduced in line with the decreased rate of usage. Competition for the restricted steel markets was heavy, resulting in extensive price reductions and tightening of specifications.

Production of acid-grade fluorspar presented a somewhat brighter picture and was expected to reach about 160,000 tons, approximating the 1953 record. For the first time consumption of fluorspar for the manufacture of hydrofluoric acid exceeded consumption by the steel industry. Usage at acid plants, estimated at approximately 225,000 tons, was slightly above the record achieved in 1953, reflecting increased requirements of the aluminum industry for synthetic cryolite and aluminum fluoride, and growing demand for other fluorine chemicals. However, production was supported in part by Government purchases of acid-grade fluorspar contracts executed during the Korean emergency. Several purchase contracts terminated during the year, releasing considerable tonnages to the markets. Supplies were more than plentiful, and by the end of the year, prices for acid-grade spar had weakened considerably.

Domestic output of ceramic-grade fluorspar declined and was expected to total less than 30,000 tons compared with 35,000 tons in 1953. Usage at glass and enamel plants, the principal consumers, also declined to about 35,000 tons compared with 39,000 tons in 1953. With the larger markets for acid and metallurgical grade spar overfull, competition for the more limited ceramic grade markets has increased considerably. New suppliers in Mexico have entered the field in the past year or two as well as importers from European sources.

Fluorspar Statistics

Short tons	1953	Estimated 1954
U.S. production...	323,000	235,000
U.S. imports	367,000	300,000
U.S. consumption.	587,000	475,000

Several operations were shut down in 1954, including some of the larger producers in the Illinois-Kentucky district. In April United States Steel Co. announced closing of its fluorspar mines and mill near Mexico, Ky., for an indefinite period. The mill, which employed a combination of heavy media and flotation processes, had been extensively remodeled in 1953, and was one of the largest in the nation. Inland Steel Co. also closed its fluorspar operations during the year. Rosiclare Lead & Fluorspar Mining Co. at Rosiclare, Ill., curtailed output of metallurgical spar and permitted flooding of its Rosiclare mine to the upper levels. One of the largest mines in the Ill.-Ky. district, the Rosiclare has a production record dating back almost 100 years. Victory Fluorspar Mining Co., a major producer of metallurgical-grade spar near Elizabethtown, Ill., was idle throughout the year.

In the West, output from metallurgical-grade operations in Utah and Montana declined, but acid-grade production at flotation plants in Colorado and Nevada continued at a relatively high rate.

Higher Tariffs: Producers, concerned over the greatly increased volume of imports in the past few years, pressed action for revision of fluorspar tariffs during the year. In accordance with a resolution of the Senate Finance Committee, the Tariff Commission initiated a study of production, trade, imports, and consumption of fluorspar in the U.S. and the effect of the present tariff status on the domestic industry. Hearings before the Commission were held on Oct. 19, and interested parties were invited to file briefs within a 90-day period.

Government Program: In August—GSA announced that it had been authorized by the Office of Defense Mobilization to purchase metallurgical-grade fluorspar for the national stockpile; details of the purchase program were not revealed, and no purchases had been made by the end of the year.

The Internal Revenue Code of 1954 increased the depletion allowance applicable to domestic fluorspar from 15% to 23%.

DMEA received 7 applications for Government assistance in fluorspar exploration during the year and entered into contracts with 3 applicants. In 1954, 2 certificates of discovery were issued as a result of this program. As of November a total of 12 contracts with DMEA had been made.

Outlook: Fluorspar consumption is expected to recover in 1955, although it is doubtful whether the record 587,000 tons consumed in 1953 will be equalled. Consumption of metallurgical-grade spar depends on operation of the steel industry. According to reports at the end of the year, steel production was increasing. Acid-grade consumption is tied to the aluminum and fluorine-chemical industries, both of which have been operating at relatively high levels.

Fluorine chemicals, such as the fluorine refrigerants and propellants and fluorcarbon plastics, are being applied in increasing quantities to a wide variety of uses. New fluorcarbon compounds—synthetic compounds derived from hydrocarbons with fluorine replacing the hydrogen—having outstanding chemical and physical stability, and other useful properties are being developed. The field of fluorine chemistry is relatively new, and indications are that the upward trend in consumption of fluorspar as a source of fluorine will continue.

Although markets may expand, vigorous competition between domestic producers and importers probably will continue, and it is unlikely that prices will improve substantially in 1955•

MICA

Waldemar F. Dietrich
Robert D. Thomson
U. S. Bureau of Mines

IMPORTS AND CONSUMPTION in 1954 of all forms of mica block, film, and splittings were substantially less than 1953. Demand for muscovite block and film mica decreased because of a sharp decline in military orders for electronic equipment and in the rate of consumer spending for black-and-white television sets in anticipation of color sets. About 60% of the muscovite block and film mica consumed was for electronic uses.

Consumption of mica splittings was down, due mainly to substantial decreases in production of heavy electrical equipment. No data are available on the extent to which mica paper made from factory scrap mica or crude mine scrap mica has encroached on the market for products made from imported mica splittings. Lower civilian consumption of the lower qualities of mica has made it increasingly difficult to obtain strategic mica for industrial use and Government stockpiling.

Demand for ground mica was at a high level. Dry ground mica grinders were reported to be doing a capacity business because of the increased demand late in the year for roofing grades of dry-ground mica as a result of repair work for damage done by hurricanes and increased construction of new buildings. Estimated sales of dry-ground mica equaled or slightly exceeded the 60,000 tons used in 1953. Consumption of wet-ground mica increased about 6%.

Of the total muscovite block imports, 51% was Stained quality and only 10% was Good Stained and Better quality. The remaineder (39%) was nonstrategic quality. Muscovite film imports were almost entirely First and Second quality (equivalent to Good Stained and Better quality).

Purchases of domestically produced muscovite ruby and non-ruby block, film, and hand-cobbed mica by GSA continued at a high level. From mid-1952 to Nov. 30, 1954, purchases totaled 1,586,197 lb.

Prices offered during the year for nonruby Good Stained and Better quality block mica were increased in May 1954 to be equivalent to prices for similar quality ruby and the price for nonruby hand-cobbed was increased to $540 per short ton. All other prices for nonruby mica remained at 20% less than ruby mica prices.

Government Purchases of Domestic Mica

1952 – Nov. 30, 1954

	Spruce Pine, N.C. (lb.)	Franklin, N.H. (lb.)	Custer, S. Dak. (lb.)
BLOCK:			
Ruby	232,456	44,498	20,888
Nonruby	42,991	149	102
HAND-COBBED:			
Ruby	33,167	301,406	868,422
Nonruby	–	22,366	19,718
FILM	–	34	–
Total	308,614	368,453	909,130

Mica Imports and Consumption in U. S.

(Pounds)	1953	Estimated 1954
IMPORTS:		
BLOCK:		
India	2,000,196	740,000
Brazil	2,299,479	1,297,000
Other	164,493	98,000
Total	4,464,168	2,135,000
FILM:		
India	448,189	203,000
Other	2,625	200
Total	450,814	203,200
SPLITTINGS:		
Muscovite (India)	7,599,952	4,500,000
Phlogopite (Madagascar and Canada)	745,197	358,000
Total	8,345,149	4,858,000
CONSUMPTION:		
MUSCOVITE BLOCK AND FILM:		
Good Stained and Better quality	384,055	224,000
Stained quality	2,162,108	1,400,000
Lower than Stained quality	1,759,436	1,176,000
Total	4,305,599	2,800,000

From the beginning of the DMEA exploration program in 1951 through Oct. 31, 1954, 149 exploration contracts for strategic mica were executed. Of these, 120 contracts were cancelled or terminated, and 29 were still in force on Oct. 31, 1954.

Estimated cost of 114 terminated contracts was $672,490, of which the Government contracted to advance $598,414. Thirty-one contracts were certified at a value of $234,511.

Research on synthetic mica, which began in 1947, continued at the Bureau of Mines Electrotechnical Laboratory. Engineering studies on the internal resistance process for synthesizing mica, in cooperation with Mycalex Corporation of America, showed that synthetic mica (crystals of 2 in. in diameter or less) could be produced at a cost that may be commercially feasible. As a result of this, Mycalex began constructing a new plant for producing synthetic mica.

Mycalex's immediate interest is to provide for its own requirements but will sell to others.

Although synthetic mica at present is not a substitute for the strategic qualities of block and film mica, research workers are confident of ultimate success either in producing large sheets of synthetic mica or in developing means to fabricate equivalent products from synthetic flake mica. Basic advantage of synthetic fluor-phlogopite mica is that it will withstand operating temperatures above the operating range of natural mica. In flake form, therefore, synthetic mica is superior to ground natural mica in glass-bonded mica and shows promise in such applications as reconstituted sheet mica, hot-pressed or phosphate-bonded machinable dielectrics, high-temperature strain gages, various types of cermets, and numerous other applications.

International Minerals & Chemical Corp. obtained a license from TVA for recovering scrap mica from 214 acres of land around Davy Crockett Lake behind Nolichucky Dam in Tennessee. Sampling indicated that scrap-mica content in the estimated 4½-million tons of silt runs as high as 20%.

Blue Ridge Co. leased 400 acres near Penland, Mitchell County, N.C., and plans to build a dry-ground mica plant.

Construction began on a $300,000 mica-grinding plant near Santa Fe, N.M. Petaca Mining Corp., operated by Brothers of the Christian Schools, will manage the plant•

POTASH

G. T. Harley
Geological Engineer

FINAL FIGURES FOR 1954 will show that domestic production is more than 3 million tons of refined potash products, an all-time high.

Seven major companies produced potash in the United States in 1954. Five of these companies operated in the Permian Basin area of southeastern New Mexico, one in California and the seventh at Wendover, Utah.

Some potash was imported to Atlantic coast ports in the United States and Canada, at prices lower than the delivered cost of domestic potash produced at Carlsbad. Hearings are to be held before the United States Tariff Commission late in January with the possible outcome that tariffs may be established if dumping practices by foreign nations is established. Deliveries were made to 45 states, the District of Columbia, Puerto Rico, Cuba, Hawaii, Canada, and in minor amounts to a few other places. A buyers' market has been slowly developing and a summer period of slack deliveries has been evident, which has made it necessary for the companies to provide additional warehouse space to take care of excess production during these periods. This extra storage capacity has also made it possible to maintain full production crews at work thruout the year, with few exceptions.

Two new companies will start plant construction shortly, according to announcements made, and it is expected that they will be in production in two years or slightly longer. Freeport Sulphur Co. has completed its exploration in Eddy and Lea Counties, and thru an interlocking arrangement with Pittsburgh Consolidation Coal Co. a new company has been formed to sink shafts, develope underground workings and construct a surface plant at a total cost reported to be 15 million dollars.

National Farmers Union has entered into an agreement with Kerr-McGee Oil Industries and announcement has been made of the impending start of shaft sinking and pilot plant construction on leases held by Farmers Union east of Carlsbad on which extensive drilling has been done.

Prospecting and development continues in the Province of Saskatchewan, in Canada, and the possibility of exploiting potash known to exist in Utah is still under consideration. Several important additions to plant and changes in mechanical operation have been made or are in the making. One of the most interesting of these is the study of continuous miner operation as compared with a method using the 10-RU rubber tired Universal cutter, a multiple drill unit mounted on rubber tires, with conventional blasting, and loading with Joy tractor mounted loading machines loading into shuttle cars.

United States Potash Co. in the Permian Basin area has completed its #3 shaft and haulage road connecting with the #1 hoisting shaft. The #3 shaft is approximately six miles north of the #1 shaft. A larger type (I-CM) Joy continuous miner is in experimental operation at the mine and is expected to show operating and tonnage advantages over those originally installed in the district, the (4-JCM). A new storage warehouse for finished products has been practically completed at the refinery.

Potash Company of America contracted during the past year for what will be the nation's longest underground conveyor system, approximately 7¼ miles in length. The longest underground belt system now in operation is said to be 5½ miles in length and in operation in a Pennsylvania coal mine. It is also reported that PCA has, as a result of extensive research work, found a new application for the flotation of potash salts.

International Minerals and Chemical Corp. has introduced the I-CM continuous miner, and altho the ore in this mine appears to be somewhat harder than at USPCo, the machine is demonstrating its advantage over the 4-JCM type machine. A new warehouse for the storage of finished products is in use, and a plant to utilize heretofore waste magnesium chloride liquor has been put in operation to convert this material to hydrochloric acid and various high quality grades of magnesium oxide.

Duval Sulphur & Potash Co. is continuing with its program of dieselization with the purchase of a roof bolting machine and a rubber tired grader. Diesel powered shuttle cars which have proven to be highly flexible in operation, and faster than the trolley operated shuttle car, are continuing to perform satisfactorily over the steep grades that occur in this mine. Blast hole drilling is done exclusively with rubber tired multiple drill units. Belt conveyors which have been extended in conformity with the development and production advance, are providing economical ore transportation in this track free mine. Portable crushers are used in the mine to reduce the size of material feeding onto the belts from the diesel and trolley powered shuttle cars. On the surface a granular plant has been added to the refining unit to satisfy customer demand for a sized product, and a second storage warehouse has been in use for the slack season build up of finished product.

Southwest Potash Corp. constructed a second storage warehouse, but beyond this apparently operated during the year without major changes.

American Potash & Chemical Corp. at Trona, California, continued to extract potash from the brines of Searles Lake, at about the usual rate. Suspended basket type centrifuges were removed from the potash circuit, and Sharples centrifuges installed in their place. Other than this no major changes were reported other than the usual replacement of worn and corroded equipment with desirable modifications as indicated.

Bonneville Ltd. at Wendover, Utah, apparently produced potash during the year at about the usual rate, with no known changes of a major nature, other than ordinary repairs and replacements.

Outlook: It is confidently expected that the long range demand for potash in the United States will continue to grow. This is due to a steady growth in population, higher standards of living, the lack of new farm areas to be opened up, and the depletion of soil fertility in those areas now under cultivation. Farmers are becoming convinced of the need to put more mineral fertilizers on the farm, and the agricultural colleges, research organizations and county agents are pointing the way to the most scientific and economic application of these materials. When the two new companies reach the production stage in the Permian Basin, competition will be especially keen, and with increased royalty, labor and freight costs, the most efficient and careful operating conditions must prevail if the companies are to maintain incomes comparable to those enjoyed in the past•

EXPLORATION

John P. Kellogg
Voltron Corp.

THIS FEBRUARY we depart from the orthodox review in Exploration to present this statistical analysis of contract drilling on the Colorado Plateau. This departure is made not only because of the intense interest in Plateau exploration, but because Mr. Kellogg's study offers useful information to exploration men wherever they may be hunting ore with drills. Here are the figures that pin-point the relative merits of core and plugbit drilling; what drilling prices should be; how bonuses pay off; and how Government drilling compares with private enterprise.

This article was written by Mr. Kellogg when he was employed by the AEC, and while it is specifically aimed at Government practice, its lessons are applicable to anyone involved in contract drilling. *The Editors*

General Comparison of Drilling Rates

Tables 1 and 2 are tabulations of drilling rates based on the average footage per drill per month. The figures in Table 1 cover 32 separate contracts, 805 drill months, 1,380,210 ft of drilling.

In Table 1 the variations in yearly rates are explained as follows: during the first 8 months of fiscal 1951 only two diamond drilling contracts operated, simultaneously, for less than two months. One contract had 10 drills, the other had 8 drills. In both cases some rigs were part-time stand-by machines, which nevertheless must be considered active drills. Wagon drilling records set at Temple Mountain and diamond drilling records set at the Carrizo project account for the high figure for fiscal 1952. In fiscal 1953 there were a number of poor contracts which account for the low rate; the rate greatly increased during the last half of calendar 1953 due to the addition of two rotary drills.

Calendar years 1951 and 1952 show an average of about 1900 ft per drill per month and this figure may be considered an empirical norm for good drilling. The actual average drilling rate for the entire period is only 1715 ft, but this includes the subnormal fiscal year 1951, and the poor contracts in 1953. Since future plans call for less diamond drilling and more rotary drilling, the figure 1900 would be a more accurate basis for estimating the amount of footage each rig should drill each month.

The figures in Table 2 are for 22 separate contracts, 460.4 drill months, 906,480 ft of drilling. The one rotary listed had been in operation only a short time. At the present writing this rig and another rotary, which is plugbitting for four diamond drills, are achieving a much higher drilling rate.

The variation among individual contractors is explained in part in the following chapters. However, statistical analyses cannot account for certain elements in poor performance—business concerns vary, and with all other factors equal there are always contractors whose performance is innately subnormal.

Analysis of Drilling Rates on Investigative Rental Contracts

A statistical study of past drilling figures (Table 3) has revealed some interesting comparisons between hourly contracts and footage contracts and between comparable hourly contracts.

Table 1.—Yearly Summaries of Drilling Rates

Period covered	Feet/drill/month (avg.)
1. Fiscal year 1951	1,361
2. Calendar year 1951	1,848
3. Fiscal year 1952	2,101
4. Calendar year 1952	1,948
5. Fiscal year 1953	1,552
6. Calendar year 1953	1,691
7. July through December 1953	1,905
8. July 1950 through December 1953	1,715

Table 2.—Comparison of Contractor Drilling Rates

(Average feet per drill per month)

	Footage contracts				Hourly contracts[b]	
Contractor	Straight[a] diamond drill	Investigative[b] diamond drill	Wagon drill	Rotary drill	Diamond drill	Wagon drill
"A"	2,191				1,103	3,018
"B"	788		1,702		681	
"C"	1,323					
"D"			8,743			
"E"			11,965			
"F"	2,042					
"G"	1,470					
"H"	1,679					
"I"				5,314		
"J"		887				
Averages	1,750	887	6,258	5,314	969	3,018

[a] Exploration for and development of ore deposits.
[b] Drilled for geologic information.

Table 3.—Drilling Rates for Different Types of Contracts

Individual diamond drilling contracts	Feet/drill/month (avg.)
1. Development drilling, Moab Area	1,956
2. Development drilling, San Rafael Swell	1,780
3. Polar Mesa exploration	1,374
4. Eastern Carrizo exploration	2,941
5. First investigative rental contract, White Canyon	688
6. Investigative rental contract, Monument Valley	673
7. Second investigative rental contract, White Canyon	925
Individual wagon drilling contracts	
8. Temple Mountain dry hole	8,743
9. Investigative rental wagon drill	3,018

Table 4.—Hours Delay Time per Drill per Month

Contract	Government delay	Mutually agreed delay	Contractor delay	Total delay
First investigative rental contract, White Canyon (Item 5)	19.1		5.7	24.8
Second investigative rental contract, White Canyon (Item 7)	24.7	6.7	12.8	44.2

Most notable feature in Table 3 aside from the expected difference between diamond drilling and wagon drilling, is the low rate of drilling on investigative rental contracts. The rate of drilling in items 5 and 6 is about one-third of normal and the rate in item 7 is slightly under one-half. Similarly, the rate of drilling in item 9, the investigative wagon drill, is about one-third of the rate of comparable wagon drilling in item 8, a footage contract at Temple Mountain. From this comparison a factor of from one-third to one-half may be reasonably applied to rental drilling rate expectancy. As will be explained later, the factor of one-third is subefficient since the costs per foot rise above those on footage contracts; conversely, a factor of one-half, when applied to rental drill rates, brings the cost per foot well below those rates paid to footage contracts.

There is a complex of reasons for this low rate of drilling on rental contracts, but all reasons are involved with two main factors, in themselves interrelated. One factor is the purpose of investigative drilling which, by its very nature, calls for experimentation, numerous moves, and interrupted drilling. Certain phases of geological investigation call for more controlled drilling and frequent delays, so that the geologist may study results without being under pressure. The second major factor is lack of incentive on the part of the contractor.

A driller paid by the hour has little reason to strive for rapid drilling that will reduce the number of hours for which he will be paid. This lack of incentive is, of course, reflective of the experimental purpose of the drilling, which puts the emphasis on control rather than rapid drilling. The driller feels that there is no urgency, and he slackens in his performance. The question may arise of whether the freedom of control over drilling operations is sufficient to justify the lowered rate of drilling. To answer this question it is necessary to consider costs.

Regarding the question of costs per foot of diamond drilling, there is a fortuitous comparison that furnishes an answer. Items 5 and 6 in Table 3 illustrate rental-drill projects that not only have the lowest drilling rates but also the highest costs, while item 7 illustrates a rental-drill project that has a slightly increased drilling rate but a cost per foot that is lower than average. Considering $3.00 a ft as average Colorado Plateau cost for diamond drilling, the $4.25 paid in items 5 and 6 is 142% of normal, and the $2.76 paid in item 7 is 92% of normal. Furthermore, the contract in item 7 favored the contractor in stand-by payments, so that the difference between the two would be even greater if all conditions were equal.

But disregarding this minor point, the fact remains that for two comparable rental-drill contracts, the first contract, including White Canyon and Monument Valley, cost 54% more per foot than the second White Canyon contract. The reason can only be that on the second contract the contractor was conscientiously attempting to maintain good will and a reputation for efficiency, even though he was losing money by so doing.

What Analysis of Rental Contracts Shows

Any analysis of rental contracts paid by the hour and contracts paid by the foot drilled must inevitably arrive at the following algebraic proportions: the more feet drilled per hour on an hourly contract the cheaper the drilling to the Government and the costlier the drilling to the contractor. On the other hand, the more feet drilled per hour on a footage contract the cheaper the drilling to all parties. We may therefore expect that economics alone is sufficient to produce superior performance on footage contracts, but that integrity of the contractor determines the drilling performance on hourly contracts.

This conclusion is supported further by experience with wagon drilling. The drilling rate for item 8, the footage contract at Temple Mountain, was nearly three times the rate for item 9, the investigative rental wagon drill. The footage payment to item 8 was $1.02 per ft, and to item 9 was $0.65 per ft. The first contractor, who drilled three feet to the second contractor's foot, realized a profit, and the second contractor lost money. If the second contractor had drilled more feet per hour he would have lost even more money. Thus, we have a paradox wherein the lower cost per foot meant less efficient operation for the Government, and less profit to the contractor. Obviously, a comparison of costs per foot for different contract types may be an untrue comparison.

An analysis of the two contrasting investigative rental diamond drill contracts at White Canyon, items 5 and 7 in Table 3, supports the conclusion that drilling rates and costs on rental contracts are dependent solely on the contractor's will. This study consisted of comparing the delay time for each project to see whether, on the basis of actual drilling time, the drilling rates would be more nearly the same. It proved the reverse—the difference was even greater, because the contractor with the highest rate had less actual drilling time. Therefore, he must have drilled faster. For a valid comparison the common denominator used was the number of hours of delay time per drill per month. Table 4 breaks this down by causes for delay.

A further breakdown of Government delay shows almost identical proportions at each project: for access road delay and waiting for drill site completion, 9.1% for item 5 and 11.2% for item 7; for water delay, 90.9% for item 5 and 88.8% for item 7. A further breakdown of contractor delay shows that all delay on item 5 was due to tools and equipment, and all delay on item 7 was due to contractor's absence.

It should be noted that the item 7 contract which had the lower cost per foot and higher drilling rate, had the most delay for all causes. With equal delay time for both contracts the difference in drilling rate and costs would be even greater. This should be proof that the contractor for item 7 drilled more feet per hour while actually drilling; even though he drilled less hours, his overall rate was higher. For this he received less money per hour than did the first contractor, who cost the Government $1.50 more per foot.

Final conclusions are these: hourly contracts should be kept at a minimum because the Government has no control over drilling rates or costs per foot. It is suggested that hourly rental contracts contain a feature whereby average footage per month does not fall below 900 for

Table 5. Summary of Drilling Data for Certain Areas*

Total number of holes	1,696
Total footage	207,693
Total non-core footage	64,378
Total core footage	143,315
Weighted averages	
Cost per foot, core	$ 2.776
Cost per foot, non-core	$ 2.586
Difference in cost per foot	$ 0.19
Hole depth in feet	122.5
Feet of core per hole	84.5
Percent of hole cored	69
Ore horizon thickness (including safety margins)	64.2
Percent of core in ore horizon	76
Feet of extra coring	20.3
Total extra cored footage	34,429
Cost of extra coring	$ 6,542
Total cost per hole	$332.74
Cost per hole for extra coring	$ 3.86
Percent of extra coring cost	1.16
Percent of extra coring footage	24

*Areas include Polar Mesa, Yellow Circle, Seven Mile, Temple Mountain, Green Vein, and Eastern Carrizo.

Table 6.—Comparison of Results of Different Contracts

Group	Drill months	Total footage	Ft per drill per month (Avg.)
1. Diamond drilling footage contracts with bonus	114.5	270,125.1	2,359
2. Same, without bonus	69	85,691.4	1,242
3. Diamond drilling, hourly contracts, time bonus	28	25,910.7	925
4. Same, without bonus	20	13,629.4	681
5. Wagon drilling, footage contracts with bonus	11	96,174.0	8,743
6. Wagon drilling hourly contracts, with time bonus	8.2	29,336.2	3,018

diamond drilling, or below 3500 ft per month for wagon drilling. At the prevailing prices per hour anything above these figures ensures cheap drilling for the Government.

Analysis of Core-Plugbitting Ratios in Relation to Costs

Core-plugbitting ratios were studied at several completed projects to determine what savings might have been achieved by doing more plugbitting. The study is incomplete and should be regarded merely as an indication rather than as a statistical analysis. This incompleteness is due to several factors: the necessary data are available only for diamond drilling done at recently completed footage contracts, and the comparisons were made for only four projects—Polar Mesa, development drills No. 1, development drills No. 2, and Eastern Carrizos. These four projects, however, are broken down into six areas as shown on Table 5. To arrive at a figure for the minimum length of effectual coring—i.e., the ore horizon thickness plus upper and lower safety margins—it was necessary to conduct a poll among the geologists.

First conclusion to be drawn from Table 5 is that the dollar savings that would have resulted from using the total possible plugbitting would have been negligible. The total difference in dollars for 207,693 ft of drilling is only $6,342, or 3c a foot. For the 1,696 holes cored at all six areas the cost per hole for extra coring is only $3.86. As the total average contract cost per hole was $332.74, the extra coring cost is only slightly over 1%. None of the six areas was excessive in coring or in any way strongly divergent from the norm.

Saving in time is undoubtedly a significant factor in favor of plugbitting but there are no figures available at present to confirm this.

Second conclusion deduced from Table 4 is that the first conclusion is true only in regard to dollars. The footage differential presents another picture. A total of 34,429 ft of extra coring is 24% of the 143,315 ft total coring, or about one unnecessary foot for every 4 ft cored. The actual possible dollar saving presented under the first conclusion is negligible because the cost differential between coring and plugbitting is negligible, but had this differential been large, the possible dollar saving might have been significant.

This leads to the comparison of contractor costs for coring and plugbitting and their bid prices for coring and plugbitting. Although no detailed figures are available, there is a considerable amount of evidence which suggests that at the present bid prices the diamond drill contractor is making a much greater profit on plugbitting than on coring—particularly if the plugbitting is done with air. It is believed that a dollar differential between the bid price per foot of plugbitting would still enable the contractor to make more profit plugbitting than coring. Even at this conservative figure, for the 207,693 ft of drilling used in this study, the Government could have saved $34,000 by drilling the maximum plugbitting.

At the present prices then, it does not pay to emphasize plugbitting. The saving could be made only by inducing the contractors to lower their bid prices for plugbitting on contracts.

Bonus Drilling vs Non-Bonus Drilling

This analysis is based upon comparative costs and savings to the Government. For this reason only, is the Government justified in taking an interest in how drilling contractors pay their employees? Regarding savings to the Government, the incentive of bonus payment has proved to be extremely significant.

In field exploration work that consists of a continuous cycle of new projects, saving drilling time is tantamount to saving dollars. If more projects, can be completed or more feet drilled in a given time, the Government will actually have paid more money to the contractors but the total cost per foot will have dropped and more information will have been obtained and information is the object of drilling.

Thus, the most valid basis for comparing bonus drilling with non-bonus drilling is the quantity of footage delivered. The most useful figure to make this comparison is the average footage per drill per month, shown in Table 6.

For the compilation of Table 6 eight completed projects and four current projects have been grouped according to type of drilling, type of contract, and whether or not the contractor employees were paid bonuses. It is felt that the 520,866.8 ft drilled on these 12 projects is sufficiently representative to give sound conclusions.

A cursory examination of delay time indicates that both Government delay and contractor delay fail to fit any particular design insofar as either bonus payment or drilling rate is concerned.

For comparison, Groups 1 and 2 are by far the most significant. Diamond drilling hourly contracts (Groups 3 and 4) have been covered and the hourly feature precludes a

Table 7.—Government and Private Drilling on the Colorado Plateau

Fiscal year	Private Industry (estimated ft) Diamond drilling	Wagon drilling	Total drilling	Government (actual ft) USGS	AEC	Total drilling
1948.....	60,000	35,000	95,000	25,414	0	25,414
1949.....	85,000	35,000	120,000	192,001	4,650	196,651
1950.....	80,000	100,000	180,000	209,207	155,296	364,503
1951.....	120,000	250,000	370,000	269,840	202,849	472,689
1952.....	180,000	510,000	690,000	534,749	426,570	961,319
1953.....	400,000	850,000	1,250,000	711,729	425,163	1,136,892
Totals.....	925,000	1,780,000	2,705,000	1,942,940	1,214,528	3,157,468

sound comparison based on footage delivered. Group 5 and 6 (wagon drilling) have no comparative contrasting groups. However, even in these last four groups the payment of bonus conclusively indicates a higher drilling rate. The time bonus paid Groups 6 and 3 was almost negligible compared to the footage bonus paid to Groups 1 and 5.

If Group 2 had been paid the same bonus as Group 1, and had it theoretically reached the rate of 2,359 average ft per drill per month, the 69 drill months would have been reduced to 36.3 drill months and there would have been a time saving of 32.7 drill months. Assuming the average daily cost of maintaining a Government camp to be $400, or $12,000 a month, the saving to the Government would have been $392,400. At an average cost of $3.00 per foot, this saving would have paid all contractor costs in group 2, with $135,326 left over.

Comparison of Private Drilling and Government Contract Drilling

Largely on the basis of answers to a form questionnaire mailed to 117 private companies and individual operators, a tabulation has been made of non-Government drilling on the Colorado Plateau. This tabulation shows that industry drilled a total of 1¼-million feet in fiscal 1953. Nearly a million feet was drilled by seven large companies; the remainder by about 40 different operators. Most operators have indicated an intention to increase their drilling in fiscal year 1954.

In fiscal 1953, 1,136,892 ft was drilled by the Government, of which 425,163 ft was drilled by the U.S. Atomic Energy Commission, and 711,729 ft by the U.S. Geological Survey.

Table 7 is a tabulation of annual drilling totals for private industry and Government since 1948. The figures for private industry, based on yearly estimates up to the 1953 poll mentioned above, show an increase proportional to that shown by Government drilling, which suggests that they are reasonably accurate. In addition to these footage totals, private industry has been drilling sporadically since 1919, and the U.S. Bureau of Mines drilled 38,510 ft in 1943. Thus by any comparison private drilling is an important factor in furthering the uranium industry and in increasing reserves.

Most striking difference between private drilling and Government drilling is in the methods of determining favorable ground. In general, the Government is more interested in geologic guides, lithologic correlation, sampling, and mapping than is private industry, whose methods of exploration are shaped largely by economics and land ownership. It is not uncommon for operators to determine mineralization by visual examination, and to decide on drill hole locations more often by intuition and situation of claims than by geologic reasoning. Nevertheless, private industry continues to find uranium. It has a fine record of discovery, which may be accounted for to some extent simply by the overwhelming amount of drilling.

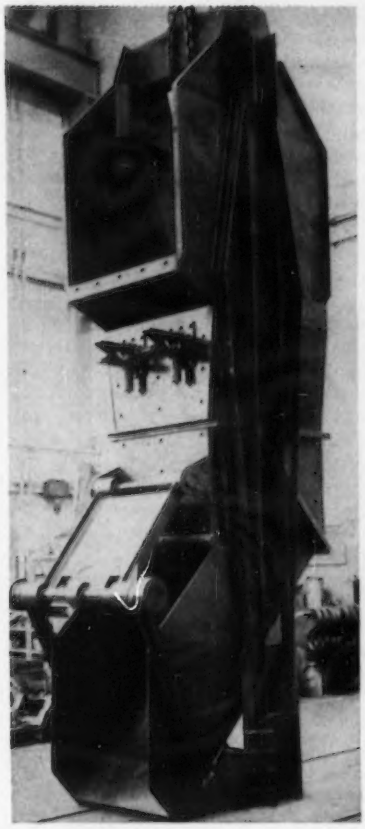
It is believed that of the 1¼-million feet drilled by industry in 1953 at least two-thirds was done by wagon drills Moreover, the average hole is much shallower than those drilled on Government contract. Private drilling is almost always either direct development behind or around known deposits or blind "wildcatting." Although industry has seldom followed a systematic pattern of exploration, and has seldom drilled purely for investigative purposes—the two types of drilling most prevalent in Government contracts — private operators are becoming increasingly aware of the practical value of such long-range programs.

In techniques and mechanics of drilling, industry tends to follow Government practices and gains by Government experience. Government drilling contracts also encourage development of innovations by creating an incentive to increase profit. Private drillers are gradually adopting Government sampling methods, and more and more operators are using probes in drill holes to determine radioactivity. In addition, private drilling uses Government-built roads and reservoirs. Most claim owners still do not accurately locate their drill holes by survey, but they are coming to realize that this is a sound and practical aid to mine development.

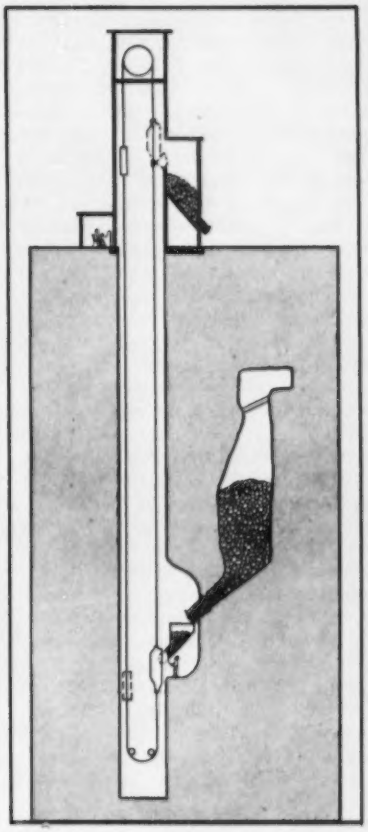
Comparison of drilling rates between private and Government drilling is difficult to make. Private drilling tends to abide less by a rigid work-day, and, as some sort of bonus is usually involved, the work-day is more likely to be longer than that on Government contracts. The few figures available indicate that private drilling rates (feet per drill per shift) are higher than on Government contracts. This is partly explained by the longer hours mentioned above, partly by shorter runs and more wagon drills, and partly by the fact that several concerns use their own drills to develop their own land. This last condition is becoming more prevalent, particularly among the larger companies and those with rich deposits.

Because of the developmental nature of their drilling, private operators are probably finding more ore per foot of hole than is the Government. This is offset somewhat by the lack of discrimination that accompanies the excitement of a current, nearby discovery. Thus, a rich strike boosts the discovery rate, but this is followed immediately by a flurry of random drilling on adjacent properties that slowly lowers the overall tons per foot.

In summary, Government contract drilling is more deliberate than private drilling, whether the latter be on contract or with company-owned rigs. This is true whether with regard to methods, time, footages, drilling rates, or discovery rates. The big contracts still are the Government's and Government yearly footages continue to increase, but private industry is growing even more rapidly. In the future the Government exploration program can probably serve best as guide, stabilizer, and technical assistant, and have complete assurance that the vigor of industry will continue a high rate of discovery•



BOTTOM-DUMP SKIPS smooth out the hoisting cycle. Popularity is increasing in many mining districts.



CANADIAN AND U.S. MINES are adopting counter-balanced friction-drive hoists.

HIGH-FREQUENCY DRILL development is now under way at Battelle Memorial Institute.

MINING

A. W. Knoerr
Managing Editor

MINING TECHNOLOGY moved ahead during 1954, with particular emphasis on hoisting, rock-drill design, improved steel and bit combinations, rock bolting and other methods of ground support, better and safer shaft sinking techniques, and new haulage and loading combinations. Since an *E&MJ* Mid-March Guidebook issue will cover the broader field of mining, this review covers some of the more significant items only.

Looking ahead, this review poses some possible practical areas of research that could contribute much to the efficiency and safety of mining.

Rotation Control Is Vital

Mine operators are continuing experiments with rotation control to achieve better drilling speeds and bit life. Standard rock drills are made with rotation speeds of 1:26, 1:30, 1:40, and can be altered from upstroke to downstroke rotation in about 20 to 30 minutes by substitution of the rifle bar and other parts. This gives six different combinations to try out for optimum drilling. Rock drill manufacturers tell us that it is hard to predict in advance which combination is best for any type of rock. The surest way is to try out combinations until the best one is found. When the nature of rock changes drastically in the mine it may be necessary to repeat experiments.

In general for long-hole drilling where considerable energy may be required to twist the long length of steel, it is best to use upstroke energy for twisting, and to use all of the downstroke energy for the punch.

In downstroke units a certain amount of twisting may take place when the bit strikes the rock. This may be desirable in some rocks; in others the twisting action may be hard on the steel and bit.

One mine on the Marquette Range tried out a downstroke "by pure circumstance" several years ago and experienced longer bit life and no thread failure. So all mine drills were converted to downstroke. However stud failure increased. In the same district another mine improved bit life by 50% by slowing down rotation on the upstroke. All of which backs up the idea that it is wise to try out various combinations when new types of rock are encountered in the mine.

Where Is Large-Hole Drilling Heading?

Although the churn drill still dominates the large-hole drilling field, it is

certain that rotary drilling is coming in fast. Prime evidence is the number of prominent equipment manufacturers who are developing and adding rotary drilling units to their line.

In one comparative test, employing the new rotary-percussion Universal Quarrymaster, rotary drilling speed was about 50% greater with the rotary attachment than with the percussion set-up. Bit costs were somewhat higher, but did not offset the overall advantage of rotary drilling.

Finger-tip rotation on large percussion drills is another improvement now under consideration, and it may add much to the efficiency of large percussion drills, particularly where the nature of a rock column changes drastically.

Although nothing can be said about the high frequency drill under development at the Battelle Memorial Institute for Drilling Research, Inc., this project constitutes one of the most significant in the field of drilling techniques. (See photo of experimental rig.)

A survey of 25 major open-pit operations in North America concluded in August 1954 showed the following primary drilling units in operation:

Type of drill	No. in operation
Churn drill 12-in.	55
Churn drill 9-in.	63
Churn drill 7-in.	5
Churn drill 6-in.	24
Wagon drill 2-4-in.	44
Rotary drills 6½-7⅞-in.	5
Auger drills 3-6-in.	2
Mobile types 2½-3-in.	15
Large percussion 3½-6-in.	9

Drillability of Rock

One recent contribution to the highly significant study of drillability of rock is the accompanying drillability table prepared by B. F. Shepherd for a paper[1] presented at the 1954 Mining Congress meeting. Drilling speeds of rock samples are related to that of Barre Granite which is rated as 1. More recently, Shepherd has added the scleroscope hardness ranges also shown to indicate relative hardness and/or abrasiveness of the samples. (See table p. 125)

Drillability as determined in the laboratory was found to parallel drillability tests made in the field with J40 jackhammers and tungsten carbide bits, thus establishing the fact that lab tests can now be made to predict drillability speeds in the field.

Other studies made by Shepherd revealed how rock fails under impact of drill bits in percussion drilling. The most efficient blow is delivered when the edge of the bit is firmly in contact with the bottom of the corrugations at the bottom of the hole. The rock beneath the edge of the bit is crushed, but wedge action of the penetrating bit wing causes adjacent rock particles to become displaced and fail by shear in a fissuring action. Thus the hardness or resistance of rock to crushing is one prime factor in drillability. The other is toughness of the rock or its ability to resist shearing action.

Another valuable paper related to drillability has been prepared by B. R. Gilbert, of the University of Illinois research staff.[2] This report shows the relationship between Mohs' scale of hardness and hardness as revealed by the Shore scleroscope. Mohs' scale is based on a scratch test, whereas the scleroscope hardness is based on rebound of a diamond-pointed hammer falling through a specific distance. This hammer accumulates a specific amount of kinetic energy measured in ergs, produces a depression (measured in cu cm) thus using up some of its energy; and rebounds a specific distance which is measure of the energy unused after impact and penetration. Averages determined experimentally were as follows:

Mohs' Mineral No.	Vol of indent, cu cm X 10^{-4}	Hardness ergs/cu cm
1. Talc	113	5.6
2. Gypsum	30	20
2.5 Galena	16.9	33
3. Calcite	5.8	89
4. Fluorite	3.4	125
5. Apatite	1.4	252
6. Orthoclase	0.8	319
7. Quartz	0.5	354

Secondary Pit Blasting

A recent *E&MJ* survey of 27 major open pit operations in North and South America reveals the following secondary blasting and breaking practices:

Method	Have tried	Are now using
Mud-capping	17	9
Drill and blast	25	23
Drop-ball	5	2
Shaped charge	10	—

About a third of the operations reported that they are using two or more methods for secondary breakage. Several indicated that they plan to try the drop-ball method, and two are switching from drilling and blasting to drop-ball. High cost seems to be the most common objection to shaped charges. New mobile units containing drill mountings and compressors account for a return to drilling and blasting in some operations.

Blasting vs Comminution

Does it pay to increase emphasis on drilling and blasting in order to cut crushing and grinding costs? Investigation of this problem of balancing mining against comminution may offer some attractive cost-cutting possibilities for the mineral industry. Any research along these lines would have to be aimed at determining costs in terms of cents or fractions of a cent per ton. Nevertheless, in a 10,000 to 50,000 ton a day operation yearly net gains might justify extensive research to find the optimum expenditure for drilling and blasting.

The first question to be answered is: What is the cost of drilling and blasting as compared with comminution? For three large open pit operations using flotation to recover concentrates, relative costs range as follows:

Drilling and blasting	100
Loading and haulage	60–90
Crushing and grinding	250–500

For another operation producing crushed limestone, actual costs were as follows:

Operation	Cost, per ton
Primary drilling	3.5c
Primary blasting	6.7c
Secondary breakage	3.1c
Coarse crushing	3.8c
Secondary, crushing screening and conveying	1.6c

In the first case, breaking costs in the pit are so much less than comminution costs, that an increase in drilling and blasting costs to assure better fragmentation (even to the finer screen sizes) might well be justified. This would of course involve experimentation with different kinds of rounds, hole spacing, and loading to find out how to get the best possible fragmentation, as well as screen analyses of rounds blasted to determine results achieved.

In the second case the possibility of getting lower breaking costs is not as attractive. Here it might be wise to concentrate on more advanced blasting techniques involving such items as millisecond delays, new-type bits, and faster drilling devices. Better fragmentation might in this case result in lower crushing costs as a collateral benefit.

1. Shepherd, B. F. "The Drilling Problem —What-Why-How?" *Mining Congress Journal*, November 1954.

2. Gilbert, B. W., "Shore Scleroscope Hardness Tests Made on Mohs' Scale Minerals from Talc to Quartz, Inclusive" Published by University of Illinois, Urbana, 1954.

Ground Support

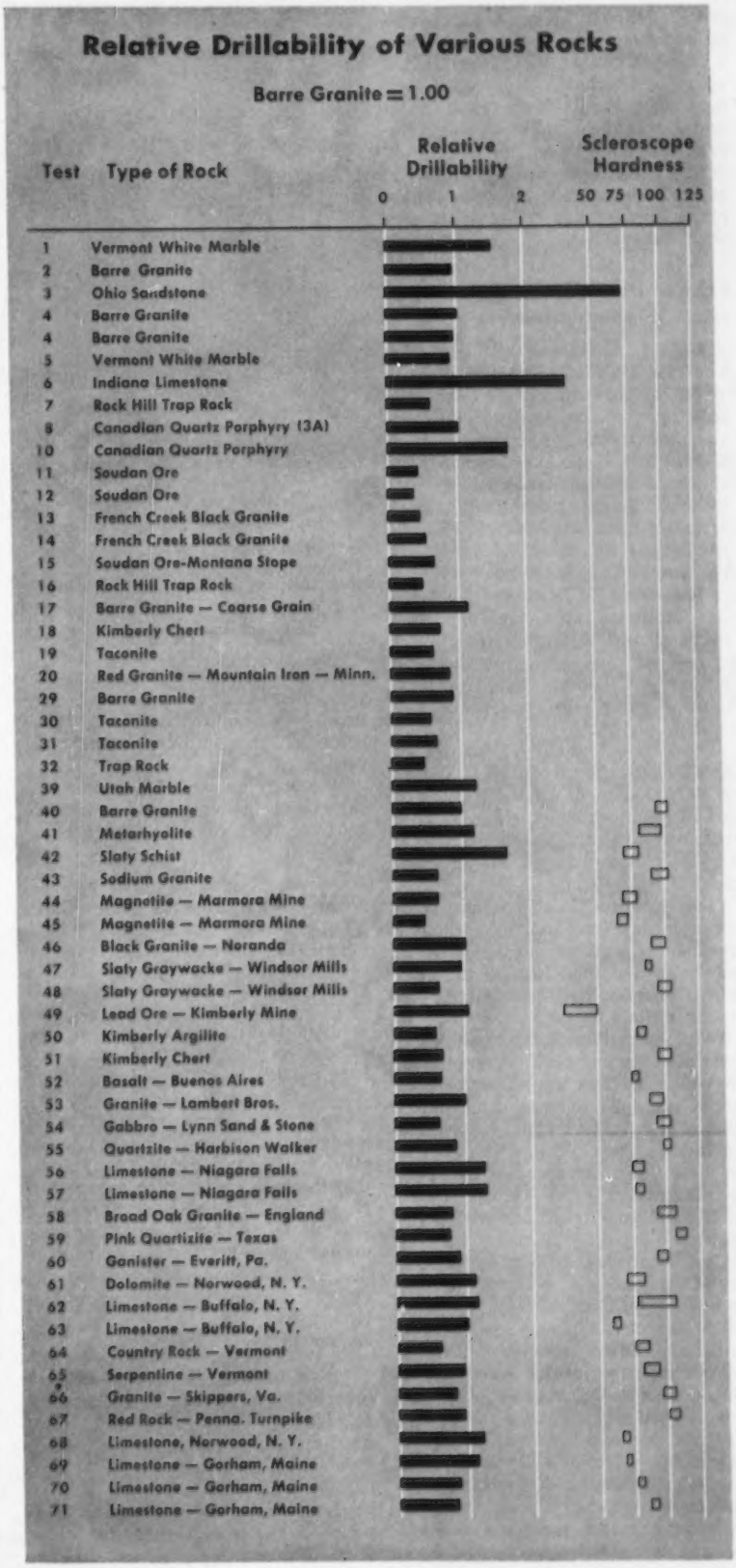
Rock Bolting. The term "roof bolting" is gradually being supplanted by "rock bolting" because this method is now being used to pin slabs to vertical and slanting faces, sides of shafts, and even toes of cliffs. In response to great interest in this fast-growing technique, manufacturers, engineers, U. S. Bureau of Mines, and mining publications have released a virtual library of information on the subject during the past year.[3] Articles and pamphlets tell us how to install rock bolts, how to test them after they have been installed, why and how rock bolts function, what kind of equipment to use to drill holes, install, and test the loads carried by the bolts.

Rock Sealing. Two mines inspected by the author in recent years raised this question: Is the strength of concrete the only factor that accounts for its ability to stabilize mine openings, when timber and steel alone failed completely in the same areas?

Case 1. Development workings in a caving operation failed completely when timbered. However when unreinforced concrete was substituted, the development openings held up consistently. It appears that the concrete should have failed in at least certain areas because the strength of concrete lining is not sufficient to withstand pressures that can buckle 10 and 12-in. timbers.

Case 2. A long development crosscut in fairly homogeneous rock was supported in certain places with plain steel sets, in others, with the same types of sets sealed in with concrete. The non-concreted steel sets failed and buckled in a number of places, but the concreted areas seemed to hold up consistently. Again it seems improbable that any pressures which can buckle steel sets would be withstood by the same sets when encased in 6 to 8 in. of concrete.

One explanation might be the fact that sealing the rock faces with concrete prevents air slaking and rock deterioration. Geologic investigations a number of years ago indicated that tabular minerals such as talc and serecite in rock planes could exert


Relative Drillability of Various Rocks
Barre Granite = 1.00
Test
Type of Rock
Relative Drillability
0
1
2
Scleroscope Hardness
50 75 100 125
1 Vermont White Marble
2 Barre Granite
3 Ohio Sandstone
4 Barre Granite
4 Barre Granite
5 Vermont White Marble
6 Indiana Limestone
7 Rock Hill Trap Rock
8 Canadian Quartz Porphyry (3A)
10 Canadian Quartz Porphyry
11 Soudan Ore
12 Soudan Ore
13 French Creek Black Granite
14 French Creek Black Granite
15 Soudan Ore-Montana Stope
16 Rock Hill Trap Rock
17 Barre Granite — Coarse Grain
18 Kimberly Chert
19 Taconite
20 Red Granite — Mountain Iron — Minn.
29 Barre Granite
30 Taconite
31 Taconite
32 Trap Rock
39 Utah Marble
40 Barre Granite
41 Meterhyolite
42 Slaty Schist
43 Sodium Granite
44 Magnetite — Marmora Mine
45 Magnetite — Marmora Mine
46 Black Granite — Noranda
47 Slaty Graywacke — Windsor Mills
48 Slaty Graywacke — Windsor Mills
49 Lead Ore — Kimberly Mine
50 Kimberly Argilite
51 Kimberly Chert
52 Basalt — Buenos Aires
53 Granite — Lambert Bros.
54 Gabbro — Lynn Sand & Stone
55 Quartzite — Harbison Walker
56 Limestone — Niagara Falls
57 Limestone — Niagara Falls
58 Broad Oak Granite — England
59 Pink Quartizite — Texas
60 Ganister — Everitt, Pa.
61 Dolomite — Norwood, N. Y.
62 Limestone — Buffalo, N. Y.
63 Limestone — Buffalo, N. Y.
64 Country Rock — Vermont
65 Serpentine — Vermont
66 Granite — Skippers, Va.
67 Red Rock — Penna. Turnpike
68 Limestone, Norwood, N. Y.
69 Limestone — Gorham, Maine
70 Limestone — Gorham, Maine
71 Limestone — Gorham, Maine

[3] "Application of Rock Bolting" by Ingersoll-Rand.

E. F. Huston "How to Install Roof Bolts," Ohio Brass Co.

"Special Roof Bolting Issue" *Haulage Ways*, June 1954, Ohio Brass Co.

A. Barry, L. A. Panek, J. A. McCormick "Use of Torque Wrench to Determine Load in Roof Bolts" U. S. Bureau of Mines R.I. 5080 also "Anchorage Testing of Mine-Roof Bolts" U. S. Bureau of Mines I.C. 5040.

H. C. Young. "Roof Bolting in Alabama Coal Mines and Iron-Ore Mines" U. S. Bureau of Mines I.C. 7678.

suprising pressures when exposed to air and moisture, and thereby produce a prying action on rock slabs. Thus it might be concluded that sealing rock faces to prevent deterioration is an important aid to ground support members. Gunniting has long been practiced in the metal mining field. The coal mining industry has also used a plastic spray called "Cocoon" to prevent roof spalling.

Friction Drive Hoist Gains Worldwide Interest

Mining magazines all over the world have carried articles on the friction-drive hoist during the past year, pointing up the impact of this development on mining. Friction drive or Koepe hoists are now installed or scheduled for installation in England, Sweden, Finland, Germany, South Africa, Canada, and the U. S. Planned installations for the U. S. now total five, and in Canada, three.

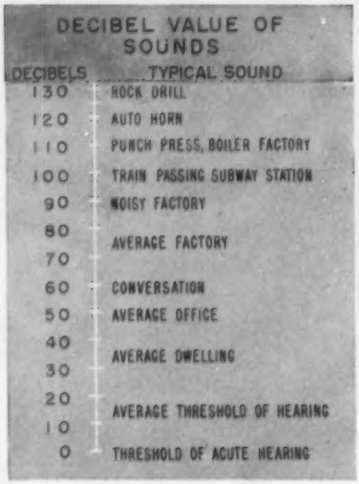
Advantages of friction-drive units are: multiple ropes (an important safety factor), less rope wear, lower peak power and power consumption in some installations, smaller drums, lighter hoisting units, and lower gear ratios in drives.

Dr. E. G. Malmlow, president of Aros Electric Co. explained to *E&MJ* recently that much of the success of the friction-drive hoist is due to close teamwork of electrical and mechanical engineers in the design and development of the unit.

This in effect, is a departure from some conventional practices where a mechanical engineer will design a certain unit, and then turn to the electrical engineer and say "Here, you make it run."

As a result of this close teamwork, here is what has been accomplished: By using multiple ropes, the size of ropes could be reduced. This meant that drum diameter could be reduced markedly. Hence drum inertia was cut way down and speed of the drum was increased.

Higher drum speed meant that the gear ratio could be cut. Smaller drums meant lower peak loads and operating loads, particularly because of the counter - balance feature. All this aided the electrical engineer, who in turn incorporated numerous features in the electrical circuit which eliminated mechanical controls. As a result maintenance has been slashed. In fact, in one Swedish installation, an American visitor asked to see the mechanical standby controls. It took the mine operator a long while to find the keys for the room—simply because the standby mechanical controls were never used, and no workers had occasion to go into the control room to service the standby equipment.



NOISE ABATEMENT is now the goal of many progressive industries in the U.S.

In the U. S., chief progress has been made in the direction of automatic hoists, and replacing mechanical controls with improved electrical circuits.

Without question, the bottom-dump skip is also gaining wider acceptance because it smooths out the hoisting cycle.

Noise—What Can Be Done About It?

Business Week (Dec. 25, 1954) points out that loss of hearing due to excessive industrial noise could cost industry as much as $2-billion. This estimate is based upon claims which have already been pressed and others which are being contemplated by employees. The above table of noise levels in the home and industry, compiled by Western Electric Co. shows that the rock drill is high on the list. Noise levels approaching 130 produce discomfort, and levels above can produce injury to hearing if sustained.

Rock drill manufacturers and industry have studied this situation, and report that three methods of noise abatement are possible:

1. Air Muffler. Noise produced by rock drill exhaust can be reduced by attaching a muffler to the drill. However, this cuts down drilling efficiency considerably. Furthermore air entering the rock drill at 70 deg F may be exhausted from mufflers at temperatures as low as 10 to 15 deg below zero. This has often produced freezing and failure of the muffler to function properly.

2. Water Muffler. Passing exhaust air through water is an effective silencer which solves the freezing problem. Objections to this method are: loss in drilling efficiency, and impracticability of lugging a water exhaust unit around while the drill position is being changed.

3. Ear Plugs. One type of ear plug has been devised to shut out loud noises and concussions but to admit conversational tones. Applicability of this plug to mining is not widely in evidence. However, assuming that some type of ear plug could be devised, the problem of training men to use such plugs would still be an uphill struggle.

Stench System Blow-Up. Injection of mercaptan in the stench warning system of Cerro de Pasco operations caused several hundred feet of air line and a receiver to blow up, fortunately not causing any injuries. U. S. Bureau of Mines was requested to investigate this unprecedented occurrence, and promptly conducted a research project culminating in Report 5090 "Elimination of Ethyl Mercaptan Vapor-Air Explosions in Stench Warning Systems." The remedy is to blend inert gases with the mercaptan.

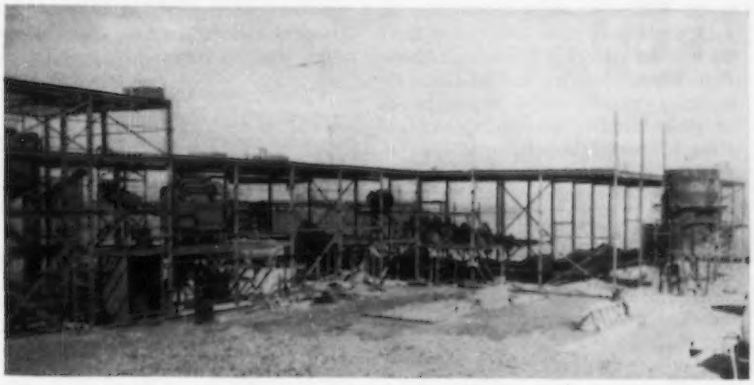
Radio Blasts? It is possible, but only remotely so, that radio waves can set off electric blasting caps according to Pamphlet 20 prepared by the Institute of Makers of Explosives. To date there has been only one authenticated case of accidental firing by radio.

Motorola company has also published a bulletin "Radio Mobile Transmitters—A Hazard to Explosives?" The bulletin concludes that a sufficient current to fire a cap can be generated under a combination of circumstances that is very unlikely to occur in actual practice.

Now since a very slight area of doubt exists, it should be a simple matter for any mining company to settle the question by hooking a set of blasting wires (no cap attached please) to a sensitive galvanometer and scanning the areas around, above, and below radio transmitting sets to determine the magnitude of currents generated, if any.

What's Your Opinion?

As pointed out in the introduction, some of the views and questions raised in this review are exploratory. The author will welcome any comment or opinions of readers to support or refute the ideas expressed. •



NEW PLANTS grabbed the spotlight in 1954. This is the uranium mill under construction at Shiprock, N. M.

MILLING

Nathaniel Arbiter
Columbia University

THE TOTAL PICTURE of the year's activity is not revealed in a single dramatic development or any one trend. Rather, there is the impression of a growing tendency toward more effective use of the whole arsenal of available equipment and unit operations toward greater overall efficiency in operation. This is shown both in the design of new plants and in the evaluation of new equipment.

New Plants

Copper continued to hold the center of the stage with respect to actual expansion of milling capacity, although developments in iron ore concentration, which are covered in detail elsewhere, indicate that this expanding branch of milling will soon challenge copper's preeminent position. In copper the uncertainties of the market forced some decrease in production at the beginning of the year, but full production had resumed by November.

The new Silver Bell mill of American Smelting and Refining started full operation after a 30-day trial run ending in April. With a flowsheet typical of Arizona practice involving three-stage crushing and single stage grinding, the design features, aimed at economies in labor and operation attracted wide attention.

The Copper Cities Mill, originally at Castle Dome, started to produce concentrate in August and refined copper by the end of the year. This unusual move of a 12,000 tpd plant involved the shutdown at Castle Dome on Dec. 5, 1953, the removal of all equipment by Jan. 18, 1954 and its transportation 15 mi to the new plant site.

Marking the rebirth of copper production in Michigan, the White Pine Mill started to produce in November after its first ball mill began to turn on Oct. 5. Each of the monster mills is grinding 1900 tons a day, with a limit not yet reached. Recovery is at 80% and grade at 30%.

The $25-million Phelps Dodge operation near Bisbee started production in August. This is the largest of the three new Arizona open pit projects to come into production. The flowsheet here is also standard, emphasizing the successful utilization of single stage grinding on the porphyry ores.

Other new developments in the copper picture include the expansion of the Bor copper mines flotation plant in Yugoslavia from 4,000 tons to 7,000 tons; scheduled operation of the Gaspé Copper Mill; and the construction of a new 4,000 ton per day mill on Cebu, P.I., with eventual capacity planned at 10,000 tons per day.

Other New Plants

A new gravity and flotation mill for **antimony** at Brasina, Yugoslavia, was in operation, producing 50% to 55% concentrates.

The world's largest asbestos mill was opened at Asbestos, Quebec, by Johns-Manville with a production capacity of 625,000 tons annually. Full operation is scheduled for 1956. The same company completed a new mill at Mashaba, Southern Rhodesia, with a capacity of 25,000 tons of fiber per year. AS&R will enter asbestos production at Black Lake, Quebec.

Feldspar production at Spruce Pine, N. C., was increased by 50% at the International Minerals and Chemicals operation.

In fluorspar Rosiclare Lead & Fluorspar closed down after 100 years of operation. Southwestern Engineering will construct a 500 tpd heavy media plant in Spain.

Expansion of lithium production capacity was very much in the news for 1954. Prospecting had uncovered new deposits and all of the companies in the field were in the throes of expansion. Foote Mineral started up its expanded mining and concentrating facilities on Oct. 1. Lithium Corporation of America will process Quebec ores for the Quebec Lithium Corp. The latter company is also building a concentrating plant. The Tinton Mill in South Dakota burned down in a disastrous fire.

Developments in manganese were in two directions, involving both milling and leaching. The rebuilt flotation plant of Manganese, Inc. resumed operation, and Manganese Ore Company plant near Henderson was back in production after a fire. A leaching plant was completed by Manhattan Chemicals Corp. for the Riverton, Minn. manganese ores. After a successful pilot plant run, commercial operation was scheduled to start in September. The pilot plant for nitric acid leaching of Maine manganese ores was reported to have been shut down.

Molybdenum production by Climax was scheduled to reach 42½-million lb in 1954. Full capacity of 27,000 tons of ore per day was reached with the start-up of No. 4 mill.

Expansion of nickel activities continued in 1954. Sherritt Gordon's concentrator started operation last November and concentrates were stockpiled prior to the opening of the processing plant with metal production starting in mid-1954. The Lynn Lake concentrator has been able to handle 2300 tpd which is 15% over its rated nominal capacity.

East Rim Nickel Mines started up its 500 ton plant in the Sudbury district and INCO's Creighton concentrator had its capacity increased to 12,000 tpd. Falconbridge Nickel is expanding production in Norway to produce 45-million lb per year. Increased production at Sudbury is also scheduled for this year.

In Cuba, Nicaro Nickel will spend $55-million for mining and processing

the Moa Bay ores while National Lead will expand production by 75% at Nicaro.

Phosphate activities in the Florida area continued to expand. Production of concentrate and pebble rock reached a new high for the quarter ending Sept. 30. Armour Fertilizer is building a new $7-million washing and flotation plant at Bartow, scheduled to start up in 1955.

Sulphur from low grade ores commands widespread interest. Italy has several plants for flotation process and several plants are scheduled to start up in Mexico, using the melting process.

Uranium industry continued to expand. South Africa's fourth and largest uranium plant was opened at the Western Reefs Mine in Transvaal with over twenty South African gold mines now scheduled to produce the metal. The Rand-Fontein has a recovery plant under construction which is scheduled to start up this year. In Northern Rhodesia, pilot plant studies are being undertaken to develop a flotation process for uranium recovery. The first uranium recovery plant in Australia at Rum Jungle started up on Sept. 17.

By-product uranium is being recovered by International Minerals and Chemicals at Bartow, Fla. and by Texas City Chemicals from its new phosphate plant at Texas City. In the former operation, 1 lb of uranium oxide is obtained from 60 tons of overburden and phosphate rock, which is ratio of concentration with a vengeance. Wemco is building a $3-million plant for uranium recovery at Shiprock, N. M., which will be the first specifically designed to treat uranium ores in the U. S. Operation was scheduled for the early part of this year. Additional plant facilities are being designed for Monticello, Utah, to treat refractory uranium ores and for Moab, Utah, to serve independent operators in Utah and Colorado.

In cobalt, Chemical Construction Corp. took over the management and operation of Calera's Cobalt Refinery at Garfield, Utah. Contract is for 2 yr and is to give Chemico an opportunity to obtain commercial scale operation. Chemico can spend up to $1-million to bring the plant up to capacity within the scheduled period. If it does, Howe Sound will pay the million; if not, Chemico foots the bill. While hindsight is always a secure basis for virtuous statements, this episode seems to reemphasize the value of pilot plants.

On a final note of sadness, New Jersey Zinc's Franklin mine and mill closed down after being in operation since 1848. Also, on an historical note, a Japanese gold mine and mill at Sado shut down after 2,000 years of operation, while planning is under way to treat copper ore in the Negev, Israel, allegedly from deposits exploited in King Solomon's time.

Unit Operations

Crushing and Grinding: Inspiration modernized its crushing, replacing four Gates gyratories and eight Symons horizontal discs by two 7-ft cone crushers. German equipment manufacturers are claiming that gyratory and cone-type crushers are outmoded by developments in impact machines. Many European plants have gone over to hammer mills even for fairly coarse crushing. American experience with such machines has always been less than satisfactory, principally because of the high rate of replacement of hammers with attendant high labor and steel cost. The Germans do not deny that frequent replacement is necessary but apparently find that their lower unit rates do not make this as costly an operating expense as in this country.

The Aerofall Mill is operating at several installations. Manufacturers claim that the large size-reduction possible with this machine makes it a substitute not only for grinding equipment but for tertiary or even secondary crushing equipment. With a resultant overall economy. One of these installations was visited by this reviewer, who came away with an impression that while the machine seems highly effective for size reduction, the materials transportation facilities leave much to be desired. This was based on the observation that the mill itself drew 300 hp to break about 80 tons per hour while an additional 300 hp was required for blowers to remove the product from the mill.

Grinding continues to hold the limelight as a unit operation, both in research and in plant developments. Several papers have appeared or are forthcoming which attempt to correlate grinding mill power with size and speed, and to correlate capacity with these variables. On the operating front there seems to be no decision in the battle between single stage grinding vs rod mill-ball mill grinding. This is perhaps as it should be. It is noteworthy that all of the new mills put up in Arizona in the last few years, as well as the White Pine Mill, employ single stage grinding, from about ½ in. to flotation size. Thus the trend towards rod mills ahead of ball mills is by no means unanimous. As with other milling problems, differences in ore character and differences in equipment forestall any universal prescriptions. The essential problem here is, of course, which grinding circuit gives the lowest operating costs at comparable metallurgy.

Classification and Sizing: The most interesting developments in this operation are the continued applications of cyclones to various problems of thickening and classification. As with other instances of the development of a new type of equipment, the use of cyclones has gone through several stages. Up until recently there has been a tendency to regard them as a cure-all for thickening and classifying problems. Their low cost, simple operation, and tremendous capacity per unit of floor space are noteworthy advantages. On the other hand, cost figures now available indicate that while first costs are much lower for cyclones over mechanical classifiers, operating costs may be significantly higher. Lewis of Tennessee Copper, for example, reports that his cyclone cost 83% more to operate than the classifier it replaced, but he believed that the difference in the initial investment still favored the cyclone.

Wear of the cyclone is often one of the most critical factors and here the nature of the solid being treated will determine in some cases whether the cycione can be used at all. For example, with coal, rubber linings proved completely unsatisfactory, but bonded abrasives had acceptable life. With clay the reverse can be true.

New developments with cyclone treatment include the wide application to primary and secondary grinding circuits in South Africa; the development of a three-product cyclone classifier with a variable external control; the use of a two-stage cyclone with a recorded higher rejection of slimes and better recovery of sand; the use of truck-mounted cyclones to produce sand for tailings dam construction; and finally tests by Erickson with 6-in. cyclone which indicate conclusively that differential grinding of iron ore can take place within the cyclone.

Equipment developments include sectionalized cyclones with rubber lining and small multi-unit cyclones reported to be able to separate in 2 to 20 micron range. Other equipment developments in the classifying field included new dry classifiers, a belt classifier designed to compete with conventional rakes or spirals and finally the world's largest spiral classifier, an 84-in. machine to be used in an iron ore washery.

Concentration: There were no spectacular developments in this field during the past year. Spirals continued to find new applications with their use on Australian beach sands for zircon and rutile separation of interest. Spirals

there are made of concrete. The final products from these plants include a rutile concentrate 97½% pure, a zircon concentrate 99.4½% pure, as well as gold and tin.

An interesting description of the use of tables was reported at San Francisco Mines of Mexico where these venerable machines remove soft galena prior to flotation in order to prevent sliming. The tabling also raises the copper-lead ratio in the flotation feed and facilitates the separation.

Flotation developments appear to be on the increase again after the more or less stagnant period of the past few years. Newsworthy items are found both in research and practice. Recent developments in flotation machines have been principally in the direction of provision for easier maintenance rather than in new design. This field continues to suffer from lack of satisfactory correlation of design with performance, and in consequence frequent instances of inability to scale up flotation results from laboratory to pilot plant or mill.

Morenci's molybdenite flotation process was described in detail; it involves the use of selective depressants for copper and iron, rather than the conventional roasting or steaming. The principal reagent used for depression is a soluble ferrocyanide. The same reagent is reported to be under test at Miami.

Potash Company of America reported a new amine flotation process for potash brine without releasing any details.

There were rumors that a new flotation process for chrysocolla had been developed at one of the eastern schools; your reviewer is pleased to report that this is a fact. Details will be forthcoming after the patent situation is clarified.

A novel application of flotation was to the separation of zircon from spiral concentrates obtained from Australian beach sands. The flotation feed is treated in boiling soap solution, followed by washing, acidification, and flotation. This results in the 99.4% zircon concentrate previously mentioned.

On the research front, studies at New Broken Hill, Australia, have shown that rock drill lubricants may have a detrimental effect on flotation. The flotation properties of pyrrhotite were described in detail. It was found that copper activation was beneficial and that acid pulps were useful, but that aeration was detrimental. The adsorption of amine by hematite was correlated with contact angle and flotation results. This study produced further evidence that the amount of adsorption necessary for flotation is far less than necessary to coat the mineral surface. Finally the role of the frother in flotation was claimed to be far more complex than hitherto had been recognized. Evidence was presented supporting the conclusion that the frother can be adsorbed by mineral along with the collector, the joint adsorption having a definite effect on flotation.

One of the important developments during the year in flotation has been the application of cyclones to desliming flotation feeds. While this is rarely necessary in sulphide flotation, it is usually a must for nonmetallics. This is probably a consequence of the presence of high specific surface minerals which do not absorb sulphide mineral collectors but readily absorb fatty acids and amines. The cyclone is used in several plants for this type of desliming and it is claimed that splits can be made readily in the 20 micron range, definitely in the 10 micron range, and as low as 5 microns if it is economically necessary.

In a related field three manufacturers have begun to market flocculating agents based on the polyelectrolyte resins. These are more familiar as soil conditioners. Although the reagents are relatively expensive, only small quantities are required and the results in terms of slime flocculation have to be seen to be believed.

Another interesting adjunct to flotation is the increased application of so-called attrition scrubbing in the preparation of flotation feeds. Although this again is usually unnecessary in sulphide flotation, it is a fairly common requirement for nonsulphides. This whole subject is poorly understood and well merits detailed study. Apparently a definite abrasion of mineral surfaces is involved and not the diffusion of reagents.

Transport and Control: Conveying continues to make news partly in the direction of large long distance installations. Planning is completed for a 110-mi long coal pipe line from Cadiz, Ohio, to near Cleveland. The line will be built by Pittsburgh Consolidation and is expected to save $1.25 a ton. Fresh coal at ⅛ in. size will be slurried and pumped at relatively high pressure. Other long distance installations are, or will be in operation at Potash Company of America's Carlsbad plant to carry ore 7¼ mi underground, at Beverly, Ohio, where a 4½-mi belt system transports 800 tons of coal per hour, crossing roads and rivers en route, and the Williamson diamond mine, Tanganyika, where Africa's largest conveyor system transports 300 tons per hour of diamond ore.

Developments in pumps are principally in the direction of design for minimizing of abrasion and thereby of maintenance costs. These include new rubber lined pumps to handle material from ⅛ in. sizes down, and the continued introduction of plastic pumps and plastic valves and pipe, principally for corrosive materials.

In the control line, a new electromagnetic flow meter can measure volume flow rates in pipe sizes from 2 to 8 in. The new Bailey density controller and recorder operating at Bunker Hill and Sullivan has led to more uniform operation and particle size control in the grinding circuit. This in turn has smoothed out flotation operations. The equipment is reported to be simple and reasonably trouble-free.

A new portable moisture meter is claimed to be able to determine the moisture content of powdered or granular material in less than 2 minutes. It is based on the generation of acetylene from calcium carbide and measurement of the resulting pressure.

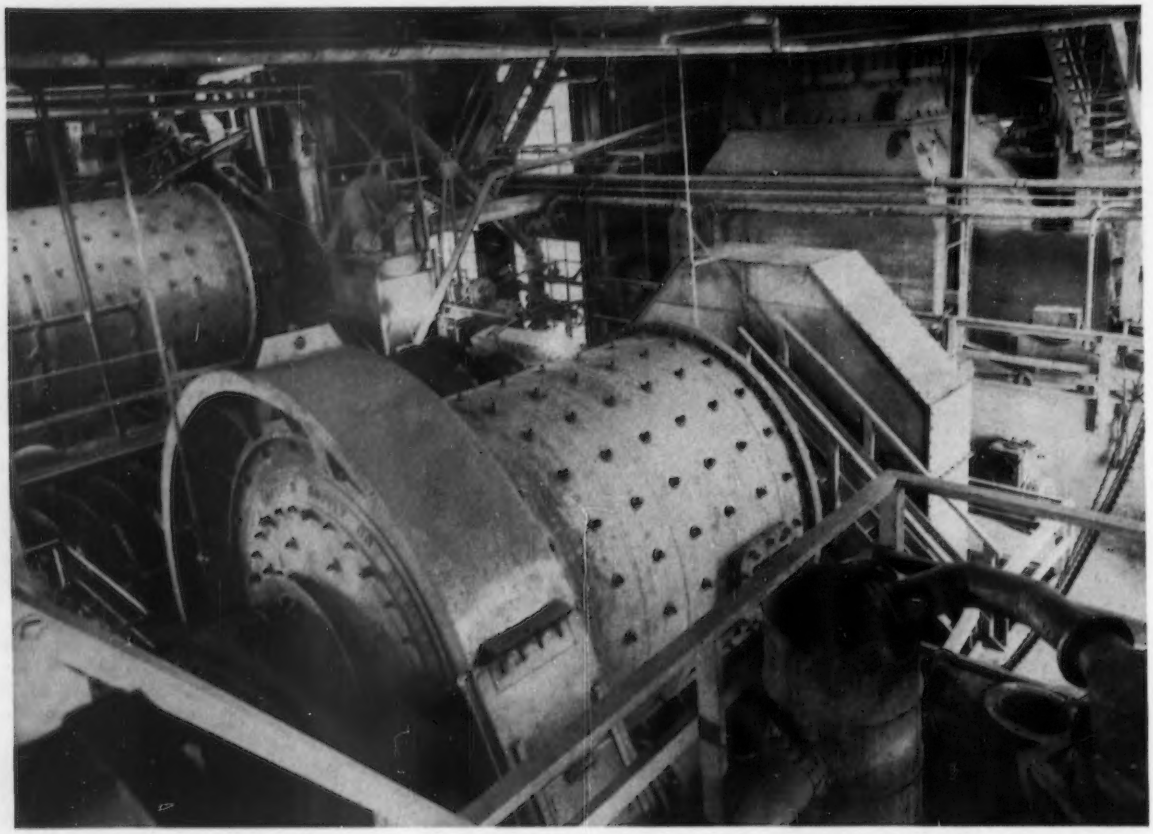
In filtration, a new magnetic filter has been developed in Sweden and a new traveling belt filter for treating coarse, fast filtering solids is available in this country.

FluoSolids: This method of roasting continues to find new applications as an accessory to milling operations. It is now being applied to obtain sulphurdioxide and a saleable iron oxide from pyrite, to roast arsenopyrite, to the roasting of zinc concentrates, and to the sulphate roasting of mixed copper zinc concentrates prior to leaching.

Golden Cycle reported on the results of its roasting at the Carlton mill. Roasting costs average about $4 per ton of concentrate, with ¼ of the total for each of operating labor and power, and 35% for repair labor and supplies.

Drying: An electric trough type heater with a screw elevator is being used to dry tungsten concentrates. The concentrates are dewatered in a 24-ft section of sheeting with square cross sections. Heat is supplied by 8 sets of 550-watt, 115v heat strips which are 24 in. long. Several applications of infra-red drying are reported.

General: The demand for technical graduates was about the same in 1954 as in 1953. In milling this has meant that more job openings were available than graduates to fill them. Starting salaries were the same or slightly higher than in 1953. Total engineering enrollment in the mineral industries for 1953-54 increased to 9,800 from 9,450 in the preceding year. This was a gain of only 4% in contrast to a gain of 9.8% for all engineering enrollment•



CYCLONES, used to close grinding circuits, as in this Erie Mining Co. taconite pilot plant (lower right), hold iron ore spotlight.

IRON ORE BENEFICIATION

Fred D. DeVaney
Pickands, Mather & Co.

THE YEAR 1954 WAS RATHER MIXED as far as the Lake Superior iron industry was concerned. Actual production of iron ore from this area was the lowest for any year since 1946. But in contrast to this, there was great activity in the construction of facilities for the production of iron ore from taconites and other low grade materials.

Actual shipments of iron ore by lake vessels for the 1954 season amounted to 60,793,697 tons. This compares with shipments in excess of 95-million tons for 1953. This drop in production of some 35-million tons was caused mainly by the low rate at which the steel industry operated throughout most of the year, and because of the very substantial tonnages present at the lower lakes at the start of the 1954 shipping season.

As might be expected, the most drastic cuts in production were made at those mines and mills which were either high cost producers or shippers of rather high silica materials. Since 1940 the Lake Superior iron ore industry has operated at close to maximum capacity in most years, and during the course of these years there has been a gradual decrease in the iron content of the ore and a corresponding increase in the silica content. With a decreased consumption such as in 1954, consumers could be more choosy as to the grade of ore mined or purchased.

The beginning of importation of iron ores from Labrador and an increase in the amount brought in from Venezuela had an effect on the domestic iron ore production both from a tonnage standpoint and also from a grade standpoint. Importation of ore from these two localities in particular and from possibly others will have an even more profound influence on the domestic iron ore industry in years to come.

Although the production of ore was relatively low in 1954, there was a great deal of activity in the concentration of iron ore. Aside from taconite, which will be discussed in some detail later, a number of new lean ore mills were placed in operation and many others were either being designed or were under actual construction.

Iron Flotation. For many years the possibility of using the flotation process for concentrating Lake Superior ores has been discussed and investigated. The first such commercial plant was put into operation in 1954 and its successful operation marks another milestone for the industry. This flotation plant is at the Humboldt Mine located at Humboldt, Mich., and is owned jointly by the Ford Motor Co. and the Cleveland-Cliffs Iron Co., with Cleveland-Cliffs as operator. At this mill, which has a rated capacity

of 70 tons per hour and an annual production of 250,000 tons of concentrates, the ore is crushed through approximately ¾-in. by gyratories and cone crushers. The ore is then ground to flotation size in a circuit consisting of a rod and ball mill, together with a Hydroscillator. The classifier overflow, which is approximately 65 mesh in size, is then deslimed in a 24-in. cyclone followed by a bank of 6-in. dia. cyclones. The purpose of this desliming operation is to discard slimes that are troublesome to the flotation process. This slime product is wasted since it has a low iron content.

Cyclone underflows are further treated in a spiral densifier to thicken the feed prior to conditioning and flotation. Flotation is carried on in both mechanical and air agitation type flotation cells in an essentially neutral pulp. The predominant iron mineral is specular hematite and this is caused to be floated away from the siliceous gangue by the use of reagents of the fatty acid type.

The flotation concentrates are then thickened and filtered on drum type filters where the moisture is reduced to approximately 8%. Final concentrate is a high grade product containing approximately 64% iron and 6% silica.

During the 1954 season filtered concentrate was shipped to steel plants where it was mixed with other coarser ores prior to sintering. Future plans for this plant include the pelletizing of the concentrates at the mill using a grate type machine. Cleveland-Cliffs Company has now under construction a much larger mill at the nearby Republic property where a similar ore will be concentrated in a like manner.

Successful adoption of the flotation process to the Michigan specularite ores does not necessarily mean that flotation will become widespread for treating all types of Lake Superior hematite. Specularite, because of its crystalline nature, is much more floatable than the earthy Mesabi hematite, and the flotation procedure which has proved so successful at Humboldt cannot be adopted directly for use on such earthy ores.

Spirals For Magnetite. Another innovation in iron ore concentration which has been in a state of development for some years and is now in full operation has taken place at Jones & Laughlin's Benson mine in New York State. At this mine, which is predominately a magnetite property, there is present a considerable amount of non-magnetic martite. Concentration of this martite, which requires 10 to 14-mesh grinding for liberation, has always constituted a problem and it is believed that the problem has now been successfully solved, at least for the coarser ore sizes, by the use of Humphreys spirals. The present plant treats martite ore at the rate of from 80 to 120 tons per hour and after grinding to 10 mesh, the material is concentrated by three stages of spirals. The first stage of spiral concentration consists of eighty 5-turn spirals which make a final tailing and a rough concentrate. In the second stage, forty 5-turn spirals give an intermediate concentrate and in the third stage, forty 3-turn spirals produce a final concentrate. Middlings are produced in all three stages which are recirculated. This final martite concentrate is essentially all minus 10 mesh and is about 10% finer than 100 mesh. Concentrate is dewatered in an internal drum filter to about 5% moisture.

The Aerofall Mill. An innovation at this plant that is being watched with interest by all concentration people is the use of an Aerofall mill for grinding the ore to 10 mesh. Prior to the installation of the Aerofall mill, the method of crushing was to use gyratories and cone crushers and to then grind the minus ⅝-in. ore in a 9½x12-ft. rod mill operated in closed circuit with 14-mesh screens. The feed to the new 17-ft inside dia Aerofall mill is the discharge from the 54-in. primary crusher set at about 8-in. and this material is ground to approximately 10-mesh in a single stage. It is understood that the power required by the Aerofall mill is substantially less than that required by the previous equipment. However, a substantial part, if not all of this power saving, is taken up in power used for driving the dust collecting system necessary with the Aerofall mill.

It is claimed that an increase in grade of concentrate is possible with this type of mill as compared to the grade that can be obtained at an identical size mesh with more conventional types of grinding equipment. An authoritative report comparing the results of these two radically different types of grinding will be awaited with interest by metallurgists confronted with grinding problems.

On the Mesabi Range, one of the largest new plants was the Oliver Iron Mining Co.'s new washing plant at the Plummer property located near the town of Taconite. Pickands, Mather & Co. put into operation a new two-unit cyclone plant as an addition to its West Hill washing and heavy media plant, constructed during 1953. Each of the two cyclone units uses two 14-in. cyclones for separating vessels in treating a minus ¼-in. plus 80 mesh wash classifier product. The capacity of the double unit cyclone plant is approximately 120 tons per hour. Skubic Brothers remodeled their Virginia mill near Eveleth, Minn., and as part of the program installed a new Telsmith scrubber and additional Remer jigs to treat the finer sizes of ore.

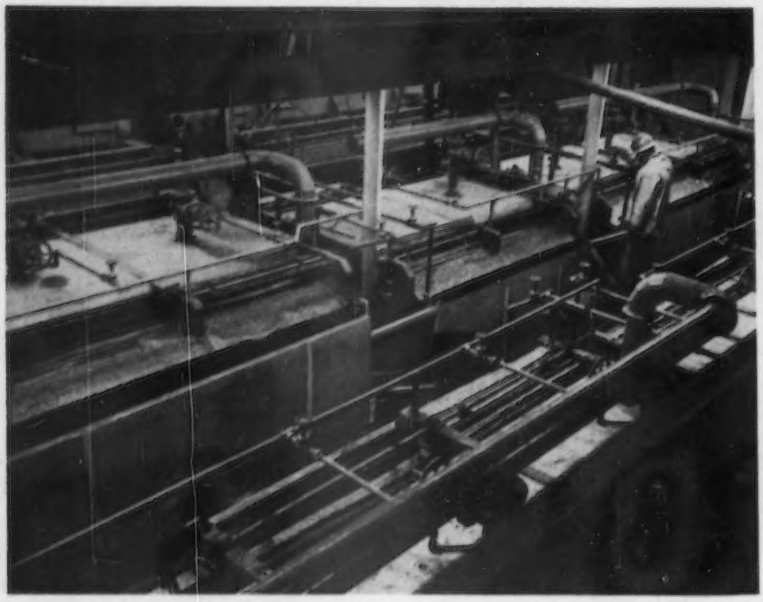
On the Cuyuna Range, the M. A. Hanna Co. installed a new cyclone plant at its Morocco property for treating a low grade classifier product. This cyclone plant has a rated capacity of 60 tons per hour. On the same range, Pickands, Mather & Co. completed their new Mahnomen mill which consists of a single unit washing plant, together with a heavy media and cyclone unit. A considerable portion of the feed to this mill will consist of lean ore which has accumulated in piles over a considerable number of years.

Another new plant on the Cuyuna Range which differs drastically from anything in the Lake Superior District is the new plant of the Manganese Chemicals Co. at Riverton, Minn. The starting material for this plant is a siliceous manganiferous iron ore and this ore is given a reducing roast in a variation of the Erie roasting furnace in which the manganese is converted to manganous form. The hematite present is also converted to magnetite.

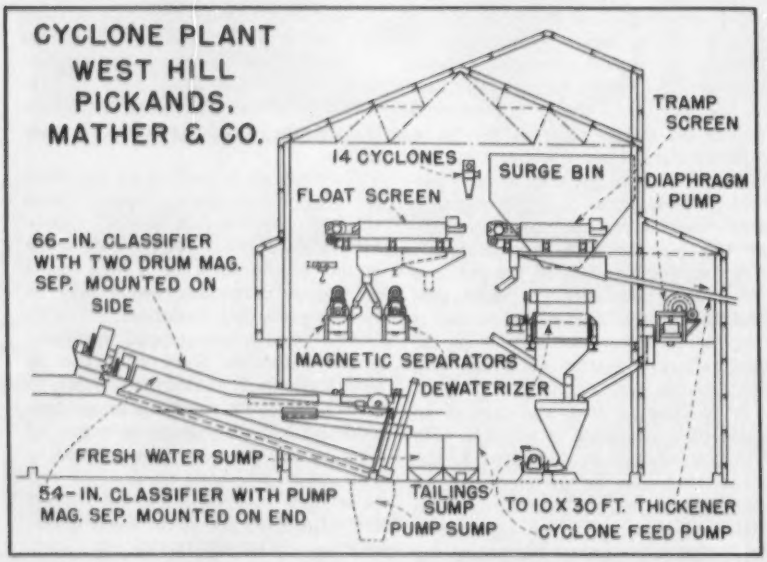
Roasted ore is leached by the Dean leaching system which employs high strength ammoniacal leach liquids. Manganese is recovered from the leach liquids in the form of a high grade manganese carbonate, which may be further processed if desired.

This plant is so equipped that manganese carbonate concentrate can be balled and pelletized in a shaft type furnace to give a pelletized manganese oxide product containing in excess of 60% manganese. As a by-product, a high grade magnetite concentrate can be secured by recovering the roasted magnetite from the spent leach liquor by magnetic concentration.

New Mesabi Plants. Although production on the Mesabi was at a relatively low ebb during 1954, the number of new mills being constructed is an indication that the operators do not view the future with pessimism. Oliver Iron Mining Co. has under construction a new large washing, heavy media, and cyclone plant at its Gross-Marble property near Marble, Minn. It is understood that this plant will be ready for production in 1956. This plant will be the first of its kind constructed by Oliver, the largest pro-



FLOTATION for Lake Superior iron ores became commercial reality in 1954 in Cleveland-Cliffs' Humboldt plant. (Hanna and Minerals Separation have run pilot plants). Humboldt uses Steffensen cells (above), a neutral pulp, and a fatty acid to float specular hematite following desliming.



NEW IDEA is working in Pickands, Mather's West Hill mill, where the scavenging magnetic separators (drum-type) are placed in the classifier pool, thus saving considerable headroom and extra equipment. (See text)

ducer of ore in this particular area.

It is also understood that the same company has under consideration plans for installing heavy media and possibly cyclone equipment at its big Trout Lake concentrator near Coleraine, Minn. This Trout Lake plant was the first plant designed to treat the so-called wash ores of the Mesabi Range and has been in almost constant operation for the past 45 yr.

Pickands, Mather & Co. has three new mills under construction on the Mesabi Range which will be ready for operation at the start of the 1955 season. These properties include an installation at the new Tioga mine which is located at the western extremity of the Mesabi Range and is of particular interest since it is in an area which is some 6 mi to the west of any producing property. The second washing, heavy media, cyclone plant will be built at the Bennett property north of Keewatin, Minn., and will treat, in addition to run-of-mine lean ores, stockpiles that have accumulated over past years. The same company has also under construction a new heavy media plant which will constitute an addition to its present Danube washing and jig plant. Previously all ores sent to this mill requiring concentration other than washing were crushed to minus ¾-in. and were treated by Conset jigs. In the new installation the minus 1¼ in. washed product will be screened at ¼-in. and the plus ¼-in. product treated by heavy media. The minus ¼-in. product will be treated by the jigs.

During recent years, the use of scrubbers for beneficiating iron ores has come into increasing use. Such scrubbers have been found to be particularly useful in disintegrating refractory painty ores and Cretaceous ores in which the matrix is a hard clay. Some operators believe that such material can be more thoroughly disintegrated by scrubbers than by the more conventional log washers, and that there are some economies in capacity, power, and maintenance. At some plants, taconite-like material is added to the feed and this constitutes additional grinding media.

Cyclones vs. Jigs

One of the most controversial subjects that has not been fully decided is the treatment of the minus ¼-in. plus 80-mesh size material. The controversy is as to whether cyclones using magnetite as a suspensoid are superior to jigs of various design. Most of the large new plants installed in the last few years by the larger companies having ample reserves have been cyclone plants. Such plants are expensive because of the relatively large expenditures that must be made for magnetic separators to recover the magnetite media.

Experience has shown that it is very poor economy, in the design of a cyclone plant, to skimp on the number and size of magnetic separators as the initial expense for the necessary separators can be soon lost through excessive consumption of magnetite.

Proponents of the cyclone method of separation claim for the process a sharper separation than can be made with jigs. Proponents of the use of jigs

claim that first cost for a jig installation is less than that for a cyclone plant and also claim that jigs will recover finer sized material than is possible with cyclones.

It has been demonstrated that to-date cyclones will make a sharp separation from ¼-in. down to approximately 35 mesh, and will do a mediocre job on the minus 35, plus 80-mesh fraction. Jigs, on the other hand, make a less sharp separation over the entire size range but do recover a mineral as fine as 150 mesh.

Comparative cost figures on the construction of cyclones versus jig plants show that if each is constructed to conform to the same engineering standards for optimum efficiency of operation, there is little difference between the two.

Magnetic Separation Grows. Use of permanent magnet drum separators is on the increase in heavy media and cyclone plants. The use of permanent magnet separators for two continuous seasons of operation has demonstrated to some of the operators that there is no diminution of strength of such separators over this period. This together with the freedom from electrical troubles and saving in media due to no power outages, has led to their increased use.

As an example of the trend, all of the magnetic separators in the cyclone section of the new Tioga mill will be of the permanent magnet type. In the heavy media portion of the plant, where ferrosilicon is used, electro-magnetic drums will be used for the primary, and permanent magnet separators for the secondary or scavenger machines, following the practice established earlier at operations such as the Biwabik and West Hill plants.

Progressively lower ferrosilicon medium losses have been achieved in many plants through the use of more magnetic separator capacity, troughed washing screens, and counterflow of wash water. One major plant reduced its medium loss to about 0.5 lb per ton of HMS unit feed and several reported losses lower than 0.90 lb.

An innovation in the magnetic circuits employed in the cyclone plants is the installation of the secondary or scavenging magnetic separator in the classifier pool. This concept originally devised by Earl Herkenhoff, of Pickands, Mather, was used throughout the 1954 season in the West Hill cyclone plant. This new concept has several advantages over the older method of installing the secondary magnetic separators as a separate unit and taking the non-magnetic product from the separator to the dewatering classifier.

The installation of the magnetic separator in the classifier pool saves considerable head room and it insures that the water level in the separator is always at the optimum height. It is a positive insurance against plugging of spigots since the entire bottom of the separator is open.

Taconite Projects Start. In contrast to the Mesabi Range as a whole, the eastern part of the Range and the north shore of Lake Superior has been the scene of tremendous activity. This activity, of course, has been caused by the huge building program being carried out by both Reserve and Erie Mining Co. in connection with their taconite projects. The operation of each company is a completely integrated one in that each, in addition to its mining facilities, will have its own railroad, its own harbor and loading facilities, and will generate its own power.

Reserve Mining Co. has its mine in the vicinity of Babbitt, Minn., and will transport the partly crushed ore by its own railroad a distance of 55 mi to the north shore of Lake Superior in the vicinity of Silver Bay. The railroad is nearing completion.

Ore will be milled on the shore of Lake Superior at a rate of approximately 30,000 gross tons per day, and from this tonnage will be produced an aggregate production of 3,750,000 tons of a pelletized concentrate per year. A new harbor, together with the necessary breakwater, is nearing completion. A power plant which will supply all necessary power for the mine and mill is being constructed in the same general area. Reserve plans on having its large plant in operation during the latter part of 1955.

Erie Mining Co.'s taconite project is being pushed vigorously. This company will have its mines and mill a distance of about 5 mi to the east and north of the town of Aurora. The ore will be pelletized at the same place. The resultant pellets will be shipped by rail a distance of 72 mi to the new harbor now under construction and designated as Taconite Harbor.

Port is in the vicinity of the towns of Tofte and Schroeder and is almost due east from the mining location. The mill which is now under construction will treat a total tonnage of 66,000 gross tons per day, which will make it the largest single mill ever constructed at one time. The capacity of this plant is rated at 7,500,000 tons of pellets per year.

Breakwaters are being constructed at Taconite Harbor and the harbor itself is being deepened to permit the entry of lake boats to the loading facilities. A large power plant will be erected near the site and power will be transmitted from there to the mill at Aurora.

Cyclones As Classifiers. Of particular interest to ore dressing people will be the choice of both the Erie and Reserve mining companies to install cyclone classifiers as a means of closing their grinding circuit. The basis for the choice of cyclones as compared to the more conventional spiral or raking type classifiers is: sharper size separation, less difficulty due to the magnetic floccing of mineral particles, lower space requirements, lower first cost, and decreased water consumption.

The decision to go to cyclones was made independently by both companies after from one to two years of continuous pilot plant operations. These tests have demonstrated among other things that the wear on cyclones is not excessive and that if rubber linings are used, such linings are good for at least a year of operation. Tests with Ni-Hard linings under more severe operating conditions show that such linings are good for at least four months of continuous operation.

One of the most difficult problems that has concerned taconite metallurgists has been the choice of the method for agglomerating the fine concentrates. There is still no unanimity of opinion as to the best process and the different companies all are carrying on this process in a different manner.

The Oliver Iron Mining Co. at its Virginia pilot plant is sintering on a conventional sintering machine and is also nodulizing magnetite concentrates in a long rotary kiln.

Erie Mining Co. is rolling its concentrates into balls and indurating these balls in a shaft furnace of its own design.

Reserve Mining Co. has announced its intention to install at its Silver Bay plant, down draft sintering machines of a design devised by Allis-Chalmers Co. of Milwaukee and McKee Co. of Cleveland.

It is understood that the Cleveland-Cliffs Iron Co. at their Humboldt, Michigan plant, which is faced with the same problem of nodulizing the hematite flotation concentrate, is considering balling the concentrate and indurating it on a traveling grate but with an updraft principle as contrasted to the Reserve Co.'s down draft machine.

It should be an extremely interesting development to watch as work progresses in each of these four plants to the point where comparisons can be made of all operating factors and of quality of results•

TITANIUM PRODUCTION. Magnesium is poured into electrolytic cell at Titanium Metals Corp. plant in Nevada.

EXTRACTIVE METALLURGY

A. W. Schlechten
Missouri School of Mines

Prologue: The task of this particular reviewer seems to become more difficult each year. Metals of interest and importance grow in number and at the same time the extractive processes increasingly utilize new techniques and new devices. One man cannot read all of the literature, much less judge it critically as to value, originality, or practicality.

As evidence of the increasing number of metals worthy of discussion, consider the Rare Metals Handbook, published this past summer, which describes the production and properties of over 34 metals, and is careful to explain that most of them really aren't rare at all, but of commercial importance. Likewise, the new 2nd Edition of Modern Uses of Nonferrous Metals is considerably fatter than its predecessor. No longer can such metals as titanium, chromium, and zirconium be dismissed by a reviewer as being simply miscellaneous alloy-forming elements.

Another facet of the problem is the great accumulation of knowledge for some metals as demonstrated by the Monograph on Copper prepared under the editorship of Professor Butts and containing a mere 936 pages.

Under the heading of new techniques and devices, one could list the mysteries of pressure leaching, fluid-bed processes, ion exchange, iodide decomposition, and liquid-liquid extractions. With an understanding of all of these matters it might become possible to comment with authority on such subjects as the separation of yttrium and terbium by elution with an ammonium salt of ethylenediaminetetraacetic acid as recently described by Spedding and Powell.

Manganese

For a number of years the only important domestic producer of manganese for FeMn was Anaconda, who sold a high manganese content MnO_2 nodule. More recently they have used these nodules in their own plant as the starting material for making standard ferromanganese and silicomanganese.

A new Western producer of ferromanganese, Pioche, has been described by Stanley Dayton. The manganese concentrates from Pioche are calcined, nodulized, and shipped to Henderson, Nev., where they are treated in furnaces located in a unit of the old Basic Magnesium plant.

There are two furnaces, each one is rated at 7500 kva and is 9 ft 9 in. x 34 ft 9 in. inside dimensions with six carbon electrodes in a row. The nodules mixed with crude ores are charged to the furnace along with coke and with lime if it is needed. Metal and slag are tapped into trays, cooled for 24 hr, and the slag barred off. Each furnace will produce 50 long tons of metal per day. The manganese recovery is 80% to 85% with 5% volatilization loss, and the remainder to the slag. Three grades of ferromanganese and silico-manganese are produced.

M. Sem has discussed the advantages of closed tops on ferro-alloy furnaces, especially those for ferromanganese. The dust can be recovered as well as a large amount of gas representing two-thirds of the heating value of the coke in the

charge. The problem of how to stoke a closed top furnace can be solved by using a rotating hearth. A closed top rotating furnace installed in Sweden has operated on manganese ore with as much as 30% fines. The power consumption has been 3000 kwh per metric ton of FeMn with 850 cu m of high calorific value gas recovered per ton of alloy. One suggested use of the gas has been to preheat the charge with a resulting saving of electrical power in the furnace. The slag from this furnace runs from 20% to 25% Mn and is used for the production of silicomanganese.

Another domestic source of manganese oxide nodules is the rebuilt plant of Manganese Inc. near Henderson, Nev. Ore from the Three Kids Mine is treated by flotation to give a concentrate running about 40% Mn. Nodulizing of the concentrate raises the Mn content to 45% or better. The nodules are shipped to Ohio for production of ferromanganese.

Several articles have appeared during the past year describing processes for the chemical treatment of low grade manganese ores or concentrates.

Pressure leach is one of those. According to L. N. Allen, the finely ground concentrate, in a slurry, is reacted with SO_2 gas, then the reacted slurry is heated in an autoclave at 450 deg F with air introduced at 600 psi. The pressure treatment is to improve the extraction and to eliminate side reaction products. The manganese sulphate solution is decanted from the residue and evaporated under vacuum to obtain $MnSO_4$ crystals which can be filtered, pelletized, and sintered to a product containing over 60% Mn.

A different sulphate process developed by the U.S. Bureau of Mines involves treating Cuyuna Range ore in a shaft furnace. The ore is first crushed through ¾ in. and the minus ⅜ in. fines are further ground and pelletized. The charge of crushed and pelletized material is fed to the upper and cooler part of the furnace where the carbonates are calcined. As the charge descends into the hotter portions of the furnace it comes into contact with a mixture of SO_2 and about 9 parts of air. With the temperature held between 600-850 deg C, this gas selectively sulfatizes the manganese, but does not convert the iron or the phosphorus to a water-soluble form. The sulfatized ore is then ground and leached by countercurrent decantation. As in the previous process, the $MnSO_4$ must be recovered by evaporation, and then it can be calcined and nodulized.

A nitric acid leach process is being investigated on a 1000-lb per hr pilot plant scale by the Nossen Laboratories. 11% Mn ore from Maine is treated with nitric acid solution at 175 to 190 deg F in stainless steel equipment. The solution is then filtered and evaporated to about 65% solids. This slurry goes to a decomposition unit which is a steam heated, stainless steel, double drum drier; here manganese nitrate breaks down into MnO_2, HNO_3, and some NO_2. The resulting MnO_2 must be ground and washed to remove impurities; then it can be flash dried and also nodulized if desired.

Uranium

Certain unclassified features of uranium metallurgy have been published in 1954. The problems and procedures for treating various types of ore have been summarized by R. D. Macdonald. He points out that only a few uranium ores are suitable for gravity concentration; that flotation is not at all selective, and that therefore, leaching is the usual method of treatment. Uranium occurs commonly in nature either in the quadrivalent (uranous) or the hexavalent (uranyl) state. The uranyl uranium is soluble in either sulphuric acid or sodium carbonate solutions; the uranous uranium is poorly soluble and must be oxidized to the uranyl form.

Acid leaching seems to be most widely used, especially in South Africa, but has the disadvantages of putting more impurities into solution, of requiring corrosion resistant equipment, and of not being applicable to ores with an appreciable amount of calcium carbonate in the gangue. In contrast, carbonate leaching can be carried out in relatively simple equipment, will produce a high grade precipitate, and the solutions are regenerated for recycling. However, the recovery may not be as good, and the operating costs may be higher.

Leaching methods used on U.S. uranium ores are described by W. L. Lennemann; (*E&MJ*, September 1954) he has outlined some of the additional problems posed by vanadium content or the presence of carbonaceous material and other impurities. He states that 18% $CaCO_3$ is about maximum for an agitation acid leach and 4% $CaCO_3$ for a percolation acid leach. The different types of ores require variations of the fundamental leaching circuits and tailings may run anywhere from 0.005% to 0.03% U_3O_8 depending on the refractoriness of the feed.

Forward and Halpern propose to make carbonate leaching more effective by using pressure methods. They emphasize the inherent advantages of carbonate leaching and demonstrate that pressure leaching at 100 deg C and under 2 atmospheres oxygen pressure gives extractions of 92 to 99% on a variety of ores including those which contain pitchblende as the chief uranium mineral. They state that oxygen gas appears to be a cheaper means of oxidation than various chemical agents.

A further development is their recovery of the uranium by the use of hydrogen under pressure to reduce the uranium to the tetravalent state so that it is precipitated from the solution as UO_2. For practical operation, the precipitation must be carried out in a pressure vessel at 100 deg to 150 deg C and with hydrogen partial pressures of 50 to 200 psi; a small amount of catalyst such as nickel powder is required. This procedure is proposed as being preferable to the older methods.

South African uranium developments have been discussed by C. S. McLean in a paper giving a general picture rather than any specific details of practice. He states that there are six uranium recovery plants operating in South Africa and 23 gold mines on the approved list for production.

The tailings from gold cyanidation plants are pulped with dilute H_2SO_4, agitated, and filtered. The resulting solutions are purified and the uranium precipitated by means not revealed. Seven acid plants have been built to supply the H_2SO_4; six of them using pyrite and the seventh operating on elemental sulphur. The pyrite plants all operate with fluidized-bed roasters. One estimate was made that the new uranium recovery plants on the Rand would require a £ 40-million capital investment with a £ 30-million gross annual revenue, but probably even a larger sum has been expended.

As mentioned above, the actual procedures for purifying uranium solutions and precipitating uranium compounds have not been revealed, but presumably UO_3 or a compound that will decompose to UO_3 will finally be obtained.

(*Please turn page.*)

COPPER leaching tanks at Anaconda's Yerington plant hold 11,000 tons of ore.

Production of uranium metal as worked out in Belgium has been described by J. van Impe. UO_2 is reduced back to UO_2 with hydrogen, mixed with ammonium bifluoride and heated to form the double fluoride, NH_4UF_5. This compound when heated in vacuum to 500 deg C will decompose to yield UF_4 in the form of a fine powder. The UF_4 is then reduced with calcium metal in a CaF_2 crucible; the resulting reaction is highly exothermic and the reaction mass must be cooled under argon or helium to avoid formation of oxides or nitrides. Recoveries are around 98.5%. Uranium metal is then vacuum melted in graphite or alumina crucibles and cast into desired shapes.

Production of uranium fluoride by wet methods, such as the reaction of UO_2 and HF solutions, is difficult, because of the problem of dehydrating the uranium fluoride without decomposing it.

Titanium and Zirconium

Titanium production continues to lag behind earlier predictions, but it should rise at a fast pace with expanded capacity at the TMCA plant in Henderson, completion of the Cramet plant in Chattanooga, and construction of the new Electromet plant in Ashtabula.

One interesting point is that the new Electromet plant and the projected Imperial Chemicals plant in England will both use sodium as a reducing agent for $TiCl_4$ rather than magnesium as in the Kroll process. The relative merits of sodium and magnesium have been debated many times. M. Sittig, writing about sodium as a reducing agent, has calculated that if sodium sells for 16c a lb and magnesium for 24.5c a lb, then theoretically it will take 30c worth of sodium per pound of titanium versus 24.5c worth of magnesium. Other seeming disadvantages of sodium are the larger volume of sodium used and sodium chloride formed, the greater heat of reaction with sodium, the smaller range of working temperature, and the smaller value of sodium chloride as a by-product compared with magnesium chloride. Possible advantages include the ease with which sodium could be pumped into a reactor.

Still another point for consideration is that it is reported that the I.C.I. titanium is produced as small granules, which would simplify leaching and eliminate crushing of the sponge. One would assume that the granules result from some unusual technique in reduction. The Degussa process specified an arrangement in which molten sodium floated on a molten NaCl-KCl layer. $TiCl_4$ was introduced into the salt layer and the reaction took place at the salt-sodium interface. If this procedure would work, the product might be granular. Dr. Kroll has speculated that gaseous sodium and $TiCl_4$ might be reacted by ejection from a nozzle into an inert atmosphere at low temperature to give a finely divided product.

Of growing interest is the problem of how to produce $TiCl_4$. Successful treatment of ilmenite to yield $TiCl_4$ has been specified by W. J. Opie as a fundamental requirement for a low cost large scale titanium industry. He points out that direct chlorination of ilmenite wastes chlorine in the formation of $FeCl_3$, the $FeCl_2$ clogs the pipe lines of the equipment, and $FeCl_2$ forms a sludge in the $TiCl_4$. The removal of iron before chlorination can be accomplished by: (a) solid state reduction of Fe, fine grinding, and magnetic separation; (b) chemical digestion of the ilmenite in H_2SO_4 followed by selective precipitation of the Ti as a hydrate; or (c) smelting of ilmenite to produce pig iron and a high titanium slag.

In the smelting of ilmenite, Armant and Sigurdson state that for chlorination purposes the slag should have a composition approaching rutile and that the presence of fluxes is detrimental, both as chlorine consumers and because the molten chlorides slow down the chlorinator. Obviously, smelting ilmenite without fluxes is very difficult, so they suggest that the goal is to, "—produce a readily chlorinatable slag, fluid at normal smelting temperatures, using fluxing agents which can be removed from the slag after smelting."

Pidgeon and Michaud have conducted experiments showing that iron can be selectively reduced from ilmenite by hydrogen-water vapor mixtures at elevated temperatures. The conditions must be made considerably more reducing to lower the oxygen content of the TiO_2 even to a small extent.

Procedures at the Titanium Metals plant in Henderson, Nev. are outlined by P. J. Maddex in a recent paper. The $TiCl_4$ is produced in the chlorinators built for $MgCl_2$ in the original B.M.I. plant. Rutile is mixed with ground coke and coal tar binder, and heated in a tunnel kiln to drive off volatiles and to coke the tar. Resulting coke is broken up, briquetted, and fed into the chlorinators which are heated by the passage of current through the charge and the underlying bed of granular carbon. Another item of interest at this plant is the fact that some of the reactors are built so that $MgCl_2$ and Mg can be removed from the product by vacuum distillation, while other reactors yield a product which is leached directly. It will be remembered that the original Bureau of Mines procedure was to leach the titanium sponge with acid and water, then later, Du Pont and the Bureau adopted vacuum distillation methods. It has been stated by R. L. Powell that new leaching procedures will produce metal equally good as that obtained by the distillation technique.

Titanium Metals has also announced the development of an automatic double melting process for 4,000-lb ingots. A vacuum is maintained in the furnace, rather than a helium-argon mixture, which permits removal of the hydrogen down to 50

parts per million. Some tests have indicated that hydrogen in titanium is very detrimental to its notch-bar toughness and has possibly been the source of reported failures in airplane structures. Probably specification limitations will be put on the hydrogen content of sponge, although, as stated above, most of the hydrogen can be removed by vacuum melting.

Various patents and proposals for new titanium production methods have been commented upon by W. J. Kroll. He points out that most of the schemes for continuous processes ignore the great tendency of the newly reduced titanium to agglomerate into a large mass or to adhere to the walls of a vessel or to adhere to a stirrer. This thwarts attempts to reduce it in the form of small particles which will be carried by a molten salt from one vessel to another. He also mentions attempts to reduce TiO_2 to TiO with magnesium and then to complete the reduction with calcium. Thermodynamic calculations show that the oxygen should be brought down to 0.07%, but unfortunately, it doesn't work out that way in practice.

Wartman, Baker, Nettle, and Homme have reported some very interesting experiments on the magnesium reduction of $TiCl_4$ in which the reduction was stopped at various stages. The reactors were then sawed in half, and the mechanism of the growth of the sponge could be determined. Other experiments fairly certainly established that much of the hardness of the sponge could be attributed to impurities in the magnesium.

The roles played by Dr. Kroll and Mr. Wartman in the development of the titanium industry with comment on the lack of recognition and reward that they have obtained is the subject of a most interesting article in *Modern Metals*. This article also summarizes the hearings of the Malone Committee with many valuable facts as to the proposed consumption of titanium by various airplane manufacturers and the plans of the producing companies.

Copper

The copper smelter of Boliden at Rönnskär as described by Herneryd, Sundstrom, and Norro is unusual in that the equipment is as large as that which would be found in an American smelter with 10 times the capacity. The purpose is to get as much of the production as possible on the day shift. Three different types of concentrate are treated: (a) high Cu and low As; (b) high Cu and high As; (c) low Cu, high As, and high Au values. The copper concentrate with high arsenic is roasted, while that with low arsenic is merely dried. The mixed calcine is smelted in an electric furnace 6 x 23.5 m inside dimensions with 6 electrodes in a row; the power input is about 8000 to 9000 kw.

When the matte averaged 35% Cu, the slag would normally average 0.4 to 0.5% Cu. In 1952 a separating wall was built dividing the furnace into two zones, then calcine from the low copper concentrates was charged at the end of furnace near the slag tap hole. This low grade material "washed" the slag so that the copper content was reduced to 0.2% and sometimes as low as 0.15%. For normal operation of the furnace a formula has been derived which relates the percent Cu in the slag to percent Cu in the matte, the silicate degree of the slag, and the CaO content of the slag.

Another interesting fact at the Boliden plant concerned the change from small converters (2x2.2 m) to large 13x30-ft models purchased in the U.S.; with the same analysis matte to the converter, the blister copper from the large converters carried more bismuth and less lead. The article explains this by stating that most of the lead is gathered in the Cu_2S and most of the bismuth is gathered in the copper. In the large converter the copper does not get stirred up and brought into contact with air and hence the bismuth content is high because air contact must continue fairly long in order to remove bismuth.

This explanation might be debatable, because L. A. Lyons writing in the January 1954 issue of *Engineering and Mining Journal* states that at Roan Antelope and also at Mufulira the converters are run very hot to eliminate bismuth in the first stage of converting. The operators at these two plants feel that as soon as copper is formed, in the converter, it collects the bismuth and this bismuth *cannot* be removed by further blowing. Most books state that bismuth cannot be removed from copper by oxidation, although an old reference in Hofman and Hayward lists bismuth as being slightly more oxidizable than copper. Possibly some change in the temperature of converting at the Boliden plant has had an effect on the bismuth content of the blister copper.

Details of converting practice and equipment at the American Smelting and Refining Co. plants have been given by F. W. Archibald. Dimensions of converters, refractory consumption, air volume, slag analysis, and operating procedures are all described. Reference is made to the elimination of lead from the blister copper by deliberate overblowing until 5 to 7 tons of copper have been oxidized. Lead-free siliceous flux is added to slag the oxide copper and prevent undue corrosion of the refractories.

Refractories in copper smelting is the subject of an article by Rochow and McGill. They point out the improvement that has been made in silica brick by greater elimination of alumina, titania, and alkalies. A maximum of 0.5% of these produces a superduty brick capable of withstanding 50 deg to 100 deg F higher operating temperatures. Among other developments, the authors mention sidewall "cans"—sheet steel containers filled with rammed basic refractory—which can be used for wall construction, especially at the slag line.

Such sidewall "cans" are used in reverb construction at Noranda according to J. N. Anderson, who has recently described the changes at his plant. In 1946 one furnace smelted as much as 2,160 tons of dry charge per day, since then two furnaces have been operated at a lower rate. The suspended basic roof made it possible to change the contours of the roof to obtain the utmost economy of fuel utilization. 2.41-million Btu are consumed per ton of dry charge. The fuel is coal running 13,970 Btu per lb and costing $12.71 per ton f.o.b. Noranda; pulverizing costs another dollar per ton. Unless this reviewer's slide rule has gone wrong, this figures out to be $1.19 per ton of dry charge for fuel. A net credit of 13% can be allowed for waste heat steam recovery, reducing the cost to $1.04. A comparison can be made with Boliden where electric smelting consumes about 400 kwh per metric ton of dry charge. On this basis, electric power would have to be obtained at 2.9 mills per kwh to match Noranda's cost.

Slag washing is one of the features of the Inco flash smelting operation as revealed in U.S. Patent No. 2,668,107. Copper-nickel concentrates are smelted by injecting them into a hot oxygen-rich atmosphere; a 57% Cu, 2% Ni matte is obtained with a slag containing 0.9% Cu and 0.15% Ni. If a low grade pyrrhotite is smelted in a similar way so as to wash the slag, the slag loss can be reduced to 0.35% Cu. Oxygen is con-

sumed equivalent to 33% of the concentrate smelted and costs only half as much as the coal normally required for smelting. Gases are obtained running 85% SO_2.

Recovery of elemental sulphur from the blast furnace smelting of a pyritic copper ore has been described by T. Kiaer. The ore is smelted with coke additions; the top gases contain sulphur plus SO_2, CS_2, H_2S, and COS which are reacted in the presence of a catalyst to give additional sulphur. Production is 115,000 tons per year.

Two new copper leaching plants, Cananea and Yerington, have been the subjects of articles authored respectively by R. C. Weed and R. H. Ramsey. Leaching plant equipment is not nearly as standardized as that used in smelters, so it is interesting to compare these two layouts.

At Cananea the copper-bearing solutions are from underground mine areas and from the leaching of waste dumps; the combined feed to precipitation runs about 2.5 gpl of Cu and the spent solution runs about 0.15 gpl Cu. The precipitation launders are 40 ft long by 5 ft wide and have stainless steel grids to hold the shredded cans. Precipitated copper is washed from the cans with high pressure water, sluiced to agitator tanks, and then pumped to the mill concentrate thickeners. Production will be over 1-million lb per month.

At Yerington, oxide ore is leached in tanks to give solutions running about 20 gpl in Cu and the spent solution is 0.06 gpl. Precipitation launders appear to be about 20 ft long by 3 ft wide from scale drawings. Precipitates are removed with a clamshell and washed in a trommel to remove unconsumed iron; they are then drained and shipped by truck and train to Anaconda. Production is around 5-million lb of copper per month.

Lead and Zinc

Very little has been written on the extractive metallurgy of these two metals during 1954. Vacuum dezincing of lead bullion is being used in England and even in Russia; for more information on the Russian practice I refer you to the Zhurnal Prikladnoi Khimii.

Speaking of vacuum dezincing, the vacuum treatment of Parkes crusts has been described previously by your reviewer, and mention was made last year of a good sized pilot plant in Brazil. Now word comes that the process is being used on a commercial scale by the Penarroya plant at Noyelles-Godault.

Problems of lead blast furnace operation have been reviewed by Haney and Hopkins of Port Pirie. They describe experiments on the sizing of coke and on varying the physical properties of sinter. Among other things, they suggest the possibility of roasting lead concentrates, mixing the calcine with fluxes, and briquetting the mixture for blast furnace charge.

Zinc concentrates can be roasted in a different type of fluid bed roaster developed by Cyr, Siller, and Steele of the New Jersey Zinc Co. Their device is a vertical furnace with a shaft of decreasing cross section; air is introduced at each level. No grate or constriction plate is used and the roasted product discharges at the bottom; the upward air blasts fluidize the charge and prevent it from dropping right through the furnace. They report that pelletized zinc concentrates were roasted to 0.1% sulphide sulphur with only 10% dust carryover. A 12-in. dia roaster had a normal capacity of 2 tons per day which could be increased to 4.5 tons if a cooler was used to remove excess heat. The roasted material was suitable for feed to a vertical retort or to a Sterling furnace; larger units are being built.

Use of a FluoSolids reactor as a source of SO_2 for H_2SO_4 manufacture with particular reference to the new plants in South Africa is the subject of a paper by Gilfillan, Arthur, and Berg. They give considerable detail as to operation and list advantages and disadvantages as compared particularly with flash roasting.

Use of split compartment reactors for treating arsenical gold ores and of multi-compartment reactors for volatilizing tin sulphide is described in the November 1954 *Engineering and Mining Journal* in an article discussing the volatilization of sulphides as a metallurgical process.

Sulphatizing roast is used at the Nossa electrolytic zinc plant according to Diego Straniero to convert the lime in the calamine concentrates to $CaSO_4$ and thus prevent excessive acid consumption in the leach. The roast also greatly reduces the chloride and fluoride content, of the concentrate. A feature of this plant is the "reverse leach" procedure similar to that used by the American Zinc Co.

A. W. Jessup has described the extraction of both copper and zinc from a single electrolyte at the Dowa plant in Japan. A mixed concentrate is roasted in a FluoSolids reactor, leached, and the solution electrolized to recover copper. Then the electrolyte is neutralized to precipitate iron, purified with zinc dust and beta napthol, and electrolized again to yield cathode zinc.

In a description of the Flin Flon Smelter, R. E. Mast and G. H. Kent have given a very interesting description of the addition of zinc plant residues to the copper reverberatory with subsequent fuming of the slag. The fuming of lead blast furnace slag is now widely practiced but such treatment of a high silica reverb slag is unusual.

Current residues and stockpile residues running about 26% Zn are added at the rate of 300 tpd to 800 tons of copper concentrate. Silica flux must be added to obtain a fluid slag, but too much will cause trouble later in the fuming furnace where high silica slags tend to freeze. About 32 to 34% SiO_2 is suitable.

The high moisture content of the current residue makes it necessary to dry the charge before roasting and to burn additional fuel in the roasters. A further difficulty results from the oxidized iron content of the residue which causes magnetite formation and build-up in the reverbs. This problem is partially avoided by retaining more sulphur in the calcine, by keeping as high SiO_2 as possible in the slag, and by running lower grade mattes.

The reverb slag running approximately 8% Zn is transferred in ladles to one of two 2000 kva electric holding furnaces where entrained matte settles out, then to the fuming furnaces. A regular fuming furnace charge is 75 tons and the complete cycle takes 180 minutes. The fume passes through waste heat boilers and U-tube coolers to the bag house; 91% of the Zn is eliminated from slag.

Epilogue: Review articles on extractive metallurgy such as this one are limited by the type of information that can be made public. This falls into two categories: First, information on commercial processes that have been well established and are well protected by patents; such developments are probably already well known to the readers. Secondly, reports, usually from college laboratories, of experiments on a small scale and of such limited extent that it is difficult to determine whether they have any commercial significance or not. We hope that occasionally you find some interesting item that you overlooked in your regular reading •

MARKETS—Trends and Prices (*Continued from page 69*)

U. S. Mine Production of Copper

Mine production of recoverable copper in the United States for the years 1950 to 1954, in tons, according to the Bureau of Mines.

Region and State	1950	1951	1952	1953	(a)1954
States east of the Mississippi:					
Michigan	25,608	24,979	21,699	24,097	23,350
Pennsylvania	4,142	5,297	3,485	3,027	3,279
Tennessee	6,851	7,069	7,620	7,829	9,036
Vermont	3,504	3,774	3,774	3,947	4,181
	40,105	41,119	36,578	38,900	39,846
Missouri	2,982	2,422	2,576	2,374	1,850
Western States:					
Arizona	403,301	415,870	395,719	393,525	378,500
California	646	921	800	382	340
Colorado	3,141	3,212	3,606	2,941	4,400
Idaho	2,107	2,160	3,213	3,136	4,600
Montana	54,478	57,406	61,948	77,617	59,800
Nevada	52,569	56,474	57,537	61,850	71,630
New Mexico	66,300	73,558	76,112	72,477	60,380
Oregon	19	11	1	9	4
Texas	2	1	18	....	....
Utah	278,630	271,086	282,894	269,496	211,300
Washington	5,057	4,089	4,357	3,740	3,600
Wyoming	....	....	....	1	1
	866,250	884,788	886,205	885,174	794,555
Alaska	6	1	....	....	....
Total United States	909,343	928,330	925,359	926,448	836,251

(a) Preliminary figures.

Iron Ore Imports

Iron ore imported for consumption in the U. S. during October and the ten months ended October, in gross tons, according to the Bureau of the Census:

	Oct.	Jan.-Oct.
Algeria	....	28,600
Brazil	37,908	520,347
British W. Africa	....	191,370
Canada	832,820	2,892,784
Chile	123,376	1,398,551
Cuba	2,135	31,866
Dominican Republic	....	85,360
Iran	....	2,953
Liberia	61,040	612,442
Mexico	18,504	108,734
Panama	....	3,800
Peru	113,652	1,707,456
Spain	....	235
Sweden	95,706	1,330,840
United Kingdom	50	354
Venezuela	450,959	3,977,202
Totals	1,736,150	12,892,894

Miscellaneous Metals, Ores, Minerals

Quotations cover wholesale lots, prompt shipments f.o.b. New York unless otherwise stated, tons of 2,000 lb. unless otherwise noted.

MISCELLANEOUS METALS

Jauary 29,1955

Aluminum ingot, 99 plus percent, lb.	23.2¢
Antimony, spot, lb., less than carload, in cases	31.97¢
In bulk, carload lots, f.o.b. Laredo	28.50¢
Bismuth, ton lots, lbs.	$2.25
Cadmium, commercial sticks, delivered, lb.	$1.70
Calcium, lb., ton lots, 98 percent, cast	$2.05
Chromium, 97 percent grade, lb., contract	$1.18
Cobalt, 9- to 99 percent, per lb.	$2.60
Germanium, lb.	$295.00
Indium, troy oz.	$2.25
Lithium, lb., 98 percent	$11.00 @ $14.00
Nickel, cathodes, lb., f.o.b. Port Colborne (a)	64½¢
Magnesium, 99.8 percent, carloads, lb., producer's plant, Freeport, Texas	27¢
Palladium, troy oz	$17 @ $21
Platinum (wholesale lots) troy oz.	$78.00 @ $84.00
Quicksilver, flask of 76 lbs., 25 flasks or more	$322 @ $324
Selenium, 99 plus percent, lb.	(b)$6.00 @ $7.25
Silicon, minimum 97 percent, carloads, lb.	18¢
Tellurium, lb.	$1.75
Thallium, 100 lb. or more, lb.	$12.50
Titanium, 99.3 plus, grade A, max. 3% iron, lb.	(c)$4.50

(a) Includes U. S. duty. (b) Depending on quantity. (c) Effective Dec. 1.

METALLIC ORES

Beryllium Ore, imported, 10% BeO, per short ton unit	$39.00 @ $40.00
Chrome Ore per long ton, f.o.b. cars Atl. ports, dry:	
44% Cr_2O_3 no ratio	$22.00 @ $23.00
48% Cr_2O_3 3 to 1 ratio	$43.00 @ $46.00
Iron Ore, Lake Superior, Lower Lake ports, long ton:	
Old Range bessemer	$10.30
Mesabi bessemer	$10.05
Mesabi, non-bessemer	$9.90
Lead (Galena), 80 percent, Joplin, Mo., ton	$187.85
Manganese Ore—Per long ton unit of Mn basis 48 percent manganese, nearby positions, subject to premiums and penalties 84 @ 86¢ c.i.f. U. S. ports, duty extra. Long-term contract nominal at 82 @ 84¢ c.i.f. duty extra.	
Molybdenum Ore, 90%, per lb. of Mo f.o.b. mines	$1.05
Columbium-Tantalum, per lb., combined oxides	$3.40
Tungsten Ore, per unit of WO_3:	
Foreign 60 percent, c.i.f. U. S. ports, duty extra	$30.00 @ $31.00
Domestic, scheelite, 60 percent f.o.b. mill	$63.00
Vanadium Ore, per lb. of contained V_2O_5 f.o.b. mines	31¢
Zinc Ore, Prime, 60 percent concentrate, Joplin, Mo., per ton	$68.00

METALLIC COMPOUNDS

Arsenous Oxide (arsenic trioxide) lb., in bbl. carload lots delivered	5¼¢
Cobalt Oxide, 72½% to 73½%, ceramic grade, per lb.	$1.96 @ $1.97½
Copper Sulphate, 100 lb.	$10.35
Germanium Oxide, lb.	$142.00

ALLOYS

Ferrochrome 65 to 69 percent, per lb. of Cr contained	24¾¢
Ferromanganese, 74-76%, net ton, seaboard	$190
Ferromolybdenum, 55 to 65 percent Mo. lb. of Mo. contained	$1.49 @ $1.57
Ferrosilicon, 50 percent per lb. of contained Si.	12¢
Ferrotungsten, 75 to 80 percent, lb. of W contained	$3.00
Ferrovanadium, per lb. of V delivered	$3.00 @ $3.25
Silicomanganese, Max. 1½ percent carbon, lb. per contracts	11.4¢
Spiegeleisen, per long ton, 19 @ 21% grade	$86.00

NON-METALLIC MINERALS

Asbestos, f.o.b. Canada (Quebec) mines (U. S. funds) ton:	
Crude No. 1	$960 @ $1,500
Crude No. 2	$595 @ $900
Spinning fibers	$321 @ $514
Shingle fibers	$150 @ $200
Paper stock	$109 @ $137
Waste	$77
Shorts	$35 @ $70
Asbestos, f.o.b. Vancouver, B. C. (U. S. funds):	
Spinning fiber, 3-K	$460
Shingle fiber, 4-K	$185
Asbestos, Vermont, f.o.b. Hyde Park:	
Spinning fibers	$279.50 @ $302.00
Shingle stock	$135.00 @ $162.00
Paper stock	$81.50 @ $115.00
Waste, stucco or plaster	$71.40
Refuse or Shorts	$34.00 @ $63.00
Barytes f.o.b. cars:	
Georgia, crude, per ton	$15.00
Missouri, 94 percent $BaSO_4$ per short ton	$13.25
Bauxite, long ton, f.o.b. point of shipment:	
Domestic crude, 50 to 52 percent (not dried)	(a) $5.00 @ $5.50
Domestic, chemical, 55 to 58 percent	(a) $8.50 @ $9.05
Domestic, abrasive, 80 to 84 percent	(a)$18.00 @ $18.50
Feldspar, bulk ton.	
Potash or soda feldspar, 200 mesh, ceramic grade	$18.50 @ $22.25
Glass feldspar, white, 20 mesh	$11.75 @ $12.50
Fluorspar, f.o.b. mines, bulk, 70% effective, ton	$32.00 @ $33.00
60% effective CaF_2	$28.00 @ $29.00
Acid 97% concentrate, bulk, ton	$47.50
Fuller's earth, f.o.b. Georgia or Florida, ton	$7.00 @ $14.00
Magnesite, per ton dead-burned, bulk, f.o.b. Washington	$38.00
Mica—Domestic, f.o.b. mines, Punch 12 to 22¢ per lb. according to size and quality. Sheet clear, 1½ x 2 inch, 70¢ to 85¢; 2 x 2 inch, $1.10 to $160; 2 x 3 inch, $1.50 @ $1.60; 3 x 3 inch, $1.80 @ $1.90; 3 x 4 inch, $2.20; 3 x 5 inch, $2.40; 4 x 6 inch, $3.15; 6 x 8 inch, $4.25. Wet. ground, very fine, $140 @ $155 per ton. Bulk sales, dry ground: $32.50 @ $70.00 per ton. Scrap $25 and up.	
Ocher, Georgia, ton, in sacks	$26.50 @ $30.00
Pyrites, Spanish, per long ton unit of S, c.i.f. Atlantic ports	Not quoted
Sulphur, Texas, mines, long ton	$25.50 @ $27.50
Talc, f.o.b. works, ton	
New York, purified	$18.50 @ $20.00
Vermont, extra white	$13.50
Tripoli, Missouri, ton:	
40 mesh, cream colored	$30.00

(a) Normal. (b) Effective Oct. 1.

IRON AND STEEL

Pig Iron, gross ton, basic, Valley Furnaces	$56.00
Steel f.o.b. Pittsburgh, billets, net ton	$64.00
Structural shapes, Pa., Ala., etc., 100 lb.	$4.25

FINANCIAL AID TO HIGHER EDUCATION

Business Aid for Our Colleges—Voluntary or Involuntary?

Previous editorials in this series have shown that:

- As a group the nation's independent, privately endowed colleges and universities are in grave financial trouble, and
- There are many different means by which business firms can extend a helping hand to these institutions.

This editorial, one of a series devoted to the financial problems of higher education, submits this proposition: **If business firms do not voluntarily go to the financial aid of higher education, there is every prospect that they will soon be providing more financial support for higher education involuntarily, through taxation.**

If this prospect materializes, one of the basic elements of a well-balanced system of higher education—a strong array of independent colleges and universities—may well be dangerously weakened if not destroyed. And in the process a potentially crucial bulwark for freedom of enterprise in the United States—that same strong array of independent colleges and universities—will be undermined.

Acceptance of these propositions implies absolutely no disparagement of tax-supported colleges and universities. These have an indispensable role in the total system of higher education in the United States. Leaders of these institutions would be among the first to agree that their position is strengthened by a strong system of independent institutions, supported privately rather than by political agencies.

What is the evidence that in one way or another, voluntarily or involuntarily, business will be giving more financial support to higher education? One impressive part of this evidence is provided by the recent rapid increase in the proportion of college and university students attending tax-supported institutions.

Rapid Shift in Enrollment

In the fall of 1952 tax-supported colleges and universities enrolled about 7.5 per cent more students than the independent institutions. In 1953 this percentage was doubled. And in 1954 the tax-supported institutions enrolled 26 per cent more students.

In the case of students entering college for the first time the relative growth of the tax-supported institutions recently has been even more striking. In 1952, the number of beginning students in the tax-supported schools, as reported by the U. S. Office of Education, exceeded those in the independent colleges and universities by 35 per cent. In 1954, just two years later, this figure jumped to 49 per cent.

Why has the proportion of students attending tax-supported colleges and universities been in-

creasing so rapidly? There are many reasons. But a dominant reason is that, in order to keep going at all, the independent institutions have been forced to make large increases in the prices they charge for instruction. The purchasing power of their endowment funds has been cut in half by price inflation. The capacity of the wealthy to supplement their endowments by gifts, as they have done in the past, has been greatly reduced by high taxes. As a result these schools have been forced to rely increasingly on higher prices for instruction (tuition as it is called in academic circles) to make both ends meet.

Since 1940, the independent colleges and universities have raised their tuition fees by an average of about 60 per cent. This is considerably less than the increase of about 100 per cent in prices generally since 1940. And it is nowhere near enough to prevent the faculty members of the independent colleges from faring miserably in terms of salaries, a matter of major national importance to which we shall return in this series. But the increase in tuition fees of the independent colleges has been much greater than the increase in the fees charged by the tax-supported schools. And that price differential increasingly tends to shunt students into the schools which are supported chiefly by taxes. Independent colleges now charge, on the average, about $580 per year for a full course of instruction while the tax-supported institutions charge, on the average, about $240.

Bigger Tax Bill in Prospect

A large increase in the total enrollment in our colleges and universities during the next decade is in prospect, particularly when the great increase in births during World War II is reflected in the number of young men and women of college age. With a total of 2.5 million students at present enrolled in our institutions of higher learning, it is estimated that the total will be over 3 million by 1960.

If this trend continues most of the anticipated increase in college and university enrollment will be concentrated in tax-supported institutions. Indeed, if the shift toward tax-supported institutions that has occurred in the last three years were to continue over the next six years at the same rate, about two million of the three million students anticipated in 1960 would be in tax-supported colleges and universities and one million in independent schools. In 1950 there was a 50-50 division in enrollment. This shift would mean, of course, a corresponding increase in the tax bill for tax-supported education. And of this bill, we can be sure that an ample share would be assessed against business firms.

No Easy Solution

The best way, of course, to put a brake on a soaring tax bill for higher education is to help the independent institutions get in shape financially to carry a larger share of the student load. For most companies the development of a mutually satisfactory program of financial aid for higher education is a complicated process. In fact, it is so complicated that some companies with an initial disposition to provide financial help are inclined to despair of working out a mutually constructive plan.

If, however, the leaders of business will contemplate seriously the only available alternative to their extending voluntary help to our independent colleges and universities, their determination to work out a plan will be strengthened. For that alternative involves a grave weakening of our system of higher education, together with an involuntary increase in the financial support of higher education by business. The increase would come through higher taxes. Contemplation of such an alternative should, if necessary, toughen the will of business firms generally to do everything possible to extend financial help to our independent colleges and universities.

This message is one of a series prepared by the McGraw-Hill Department of Economics to help increase public knowledge and understanding of important nationwide developments that are of particular concern to the business and professional community served by our industrial and technical publications.

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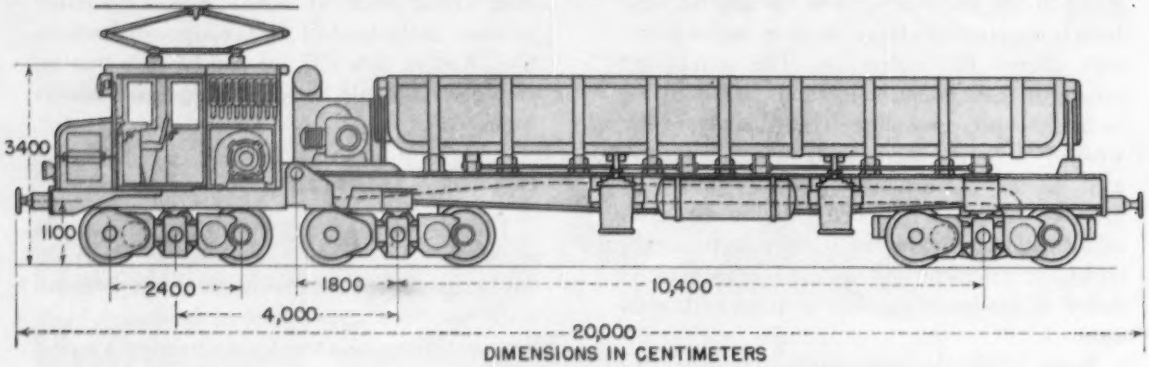
Donald C. McGraw

PRESIDENT

McGRAW-HILL PUBLISHING COMPANY, INC.

OPERATING IDEAS



Soviet Engineers Claim New Electric Rail Truck

SOVIET ENGINEERS have announced a new type of rail mounted electric truck for operation in open pit mines. The new self-powered car can carry 60 tons in one large two-way dump compartment, mounted on six axles.

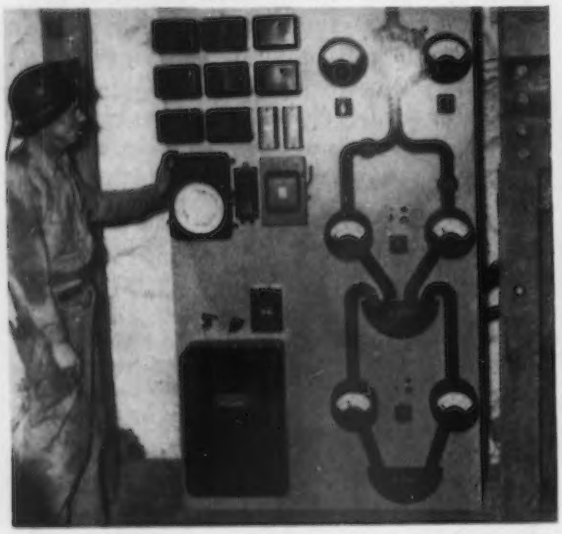
P. T. Frolow, candidate of the technical sciences of the Soviet Union, wrote in the magazine *Mechanization of Work With High Need for Labor* that several open pit mines in the Soviet Union require work 200 to 250 m below the ground surface (656.2 to 820.25 ft). To avoid costly construction of a "stretch" for the steep climb, the self-dumping, self-propelled electric truck was designed. Frolow claims the following advantages: 1) inclines up to double the normal grade can be negotiated "without difficulty"; 2) dead weight is reduced by elimination of locomotive weight; 3) consumption of electricity is reduced with less dead weight.

The power unit is fed either 1650 v or 825 v, dc, picked up by contact rail along the track. Empty weight is 90 metric tons; loaded, 150 metric tons.

All six axles are powered by type DK-8B dc motors. Frame is similar to an American semi-trailer unit capable of traveling freely around minus 75-m curves.

Three brake systems are used: a hand brake working on all 12 wheels; air brake working from a central control; and electric brakes working from the individual electric motors of each axle. Output of the motors (times 6, one for each axle) totals 1260 kw. Top speed is listed at 13.23 mph; speed with one truck filled (60 tons) and two trucks of 40 tons each (140 tons of material) is 9.31 mph.

Wagon is dumped to either side by compressed air from two E-500 type compressors.



Graphic Pump Control Board

THIS MINE PUMP CONTROL BOARD was designed by Chief Consolidated Mining Co., Eureka, Utah, to show at a glance where pumps are located, and how much power they are consuming in handling the mine's drainage problems. The company's pumping system was designed to cut down peak loads, repair bills, and pump labor.

Sack Salvages Diamonds

THIS CLOTH SACK, tied around a pipe which bleeds off coolant from diamond-wheel grinding equipment at the Carboloy plant of General Electric Co., has saved GE thousands of dollars each year. The trapped sludge is sent to a salvage company which will recover the diamonds for about $1.50 per carat for the shipper.

No "babying" needed here! "U. S." engineers designed this premium quality hose *specifically* to meet the toughest mining conditions. And it's paid off in performance in open-pit and underground mines around the world.

A universal mining hose, U. S. Matchless® withstands the highest required working pressures for both air and water, and is recommended for high-pressure water cooling of jack hammers as well as for all heavy duty hard rock use. Highly flexible in spite of its great strength, it has demonstrated time and time again its ability to take both use and abuse indefinitely.

Mandrel-made, with a wrapped finish, U. S. Matchless is available in 50 ft. lengths from any of our 27 District Sales Offices, or by writing to the address below. *Whatever* your hose requirements, you'll find it pays to turn to "U.S." There's a job-engineered U.S. Hose for practically every purpose —a staff of "U.S." engineers to assist you in your hose selection.

HANDLE WITH ABANDON!

U.S. Matchless Wire Braid Mining Hose

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- special steel wire braid gives tremendous strength—allows permanent bonding by heavy gauge rubber layer
- an additional layer of rubber under the specially coated rayon breaker protects wire against corrosion should cover be cut or damaged
- cover of carefully selected, tough, brown natural rubber fights off injury from rocks, tools, and heavy equipment

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PERSONAL NEWS

Certificates of appreciation for economic contributions of the mining industry were presented by the Silver City-Grant County Chamber of Commerce, Hurley, N. M. (left to right): **W. H. Goodrich,** Kennecott Copper; **Walter Waidler,** AS&R; **Mrs. A. A. Luck,** Luck Mining Co.; **Clarence Snell,** Empire Zinc division, New Jersey Zinc; and **Joseph Taylor,** Peru Mining Co.

Adrian C. Dorenfeld has resigned from his post with the minerals dressing department of the University of Alabama to join C. F. Braun & Co., Alhambra, Calif. as head of the ore-processing division.

Frank W. Millsaps is now metallurgist, Idarado Mining Co., Ouray, Colo.

A. H. Zielinger, superintendent of CF&I's Pueblo, Colo. plant was the recipient of the National Safety Council's highest honor, the citation for distinguished contribution to safety.

William Bianchi, formerly with the Mather iron mine, is now North Range Mining Co. mine captain at the Penokee.

W. G. Rouillard, Garfield, Utah, plant manager for AS&R, has been named manager of the firm's Tacoma, Wash. plant, replacing **Earl R. Marble,** who will retire in April. Succeeding Rouillard will be **Kuno Doerr, Jr.,** manager of the smelter at East Helena, Mont., who is himself succeeded by **Joseph T. Roy.**

Lloyd E. Antonides, mining engineer, has joined *E&MJ* as assistant editor. A graduate of Lehigh, he was an engineer-geologist with New Jersey Zinc in Wisconsin.

Hollister Jones, industrial relations manager for U.S. Potash Co., Carlsbad, N.M., has retired.

Ing. Prado Ruiz, formerly at Cia Minera de Penoles, Monterrey, is now manager of the company unit at Etzatlan, Jalisco.

Carl M. Fellman, Montreal, Wis., safety supervisor for the Montreal Mining Co., Gogebic Range, retired Dec. 1 with a service record of 45 yr with the firm.

Utah Mining Association officers for 1955 are: president, **Otto Herres;** 1st vice president, **L. F. Pett;** 2nd vice president, **Clark L. Wilson,** vice president and consultant, **A. G. Mackenzie;** secretary-manager, **Miles P. Romney;** and assistant secretary-manager, **Walter M. Horne.**

Bob Woodward, chief metallurgist and consulting metallurgist for Bucyrus-Erie for the past 20 yr, has retired from active employment with the company.

Paul H. Shaeffer has been named consultant in ferroalloys for Cleveland-Cliffs, according to announcement by **John S. Wilbur,** vice president, sales.

George W. Tower, general manager of Hochschild mining interests in South America, has recovered from a recent illness and returned to his headquarters in Lima, Peru.

Delwin D. Blue, metallurgist, has been named chief of the USBM's electrometallurgical branch at Boulder City, Nev. He succeeds **Frank S. Wartman,** who leaves the USBM for private industry.

John C. Howbert, former chief mining engineer, Gogebic Range, Oliver Iron Mining division, U.S. Steel, is now with American Metal Co. Ltd.'s Southwest Potash Corp., Carlsbad, N.M.

Luis A. Nogales has resigned from the Bolivian Mining Corp. and is working as consulting mining engineer and operating his own mines.

L. R. Redford has been promoted from mine captain to mine superintendent at the Aunor Gold Mines, replacing **A. M. Glendinning,** now with Brunswick Mining and Smelting Corp. Ltd.

N "Doc" de Voogd has returned from a six months' vacation in Europe to his post with the Comité National du Kivu, P.O. Box 91, Bukavu, Belgian Congo.

J. P. Bonneville has been named general superintendent, Quebec Lithium Corp.

Robert J. Eckley, Mead, Wash., was recently awarded grand prize in an efficiency improving contest at Kaiser Aluminum & Chemical's Mead reduction plant. His suggestion concerned a new method for removing old pot linings from cells.

William C. Shahan, graduate of the Montana School of Mines and engineer trainee with Oliver Iron Mining division, Coleraine, Minn., is now serving with the U. S. Army.

James E. Drake, former millwright foreman at the Hayden concentrator of Kennecott Copper Corp.'s Ray Mines division, has retired after 41 years' service. **Hyrum Chlarson,** who has been with the Hayden plant for 13 years, succeeds him.

Thomas A. Evans, Jr., metallurgist for the USBM, has been transferred from Mexico to the Minneapolis station of the Bureau.

Roshan Bhappu has returned from a visit to Pakistan and has resumed his work with the Colorado School of Mines Research Foundation.

Honored by Consolidated Coppermines Corp. for 25 or more years' service, were: **John Eaby,** chief clerk; **A. J. Proctor,** churn drill foreman; **F. J. Tong,** churn driller and welder; **V. D. Hall,** account-

James Earle, chief metallurgist of Cia Metalurgica Penoles, S.A., operators of the large lead smelter at Torreon, Coahuila, Mexico, and the Monterrey refinery.

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John H. Kearney (left), *E&MJ* news editor, has been transferred by the McGraw-Hill Publishing Co. to head the World News office in Mexico City, Mexico. In his new position he will supply *E&MJ* and other McGraw-Hill publications with business news of Mexico. Kearney is succeeded as news editor by **"Mike" Eigo,** former newspaperman, and copy editor of *E&MJ* for the past 18 months.

ant; **A. J. O'Connor,** vice president and general manager; **Thomas Gilmour,** master mechanic; and **Miner W. Shields,** chief electrician.

M. N. Shaw, former manager of the Salt Lake Tungsten Co.'s refinery in Salt Lake City, has been named manager of recently acquired tungsten properties in Tooele County, Utah, acquired by Consolidated Uranium Co. from Stardust Mines and Timco Uranium Corp.

R. Clair Nispel has been named superintendent of the new Deep Ruth Mine of Nevada mines division, Kennecott Copper Corp. He formerly was assistant superintendent of open pit operations at Ruth. **George E. Jennings,** former assistant open pit foreman, was named general foreman on the Deep Ruth, announced **J. C. Kinnear, Jr.,** division general manager.

Dudley L. Davis, graduate of the McKay School of Mines, University of Nevada, has been named assistant chief of the Salt Lake exploration branch, AEC.

J. C. Landenberger, Jr., former general superintendent of mines, Utah Copper division, Kennecott Copper Corp., is now general superintendent of operations. **V. S. Barlow,** mines superintendent, succeeded Landenberger and was himself succeeded by **Ernest C. Simpkins. J. A. Norden** was named assistant mine superintendent, succeeding Simpkins, and **D. O. Olsen** became director of labor relations, replacing Norden.

Philip F. Beaudin, director and senior vice president of Copper Range Co. for the past 25 yr, retired Dec. 31, 1954. Previous to his transfer to Boston, Beaudin was vice president and general manager of East Butte Copper Mining Co.

William W. Tamplin is now in Djakarta, Indonesia, with the J. G. White Engineering Corp., consultants. He will remain there until the end of 1955, working on exploration and development of mineral resources.

J. H. Whyard, engineer, is now stationed at Whitehorse, Yukon, with the Federal Department of Northern Affairs and National Resources.

Harry C. Odehdahl, concentrator repair foreman, has retired after 28 yr of service with Chino Mines division, Kennecott Copper Corp.

Jack Hayden, formerly with Cleveland-Cliffs, is now with North Range Mining Co. as metallurgist at the Book mine.

Wendell Phillips, Calumet, Mich., is now office manager of C&H's Calumet division.

Arthur Nelson, former assistant general manager of Minas de Matahambre, Cuba, has been made general manager. He was formerly superintendent at AS&R's Morning mine, Mullan, Idaho.

OBITUARIES

Guy E. Sheridan, 75, Missoula, Mont., metallurgist and co-developer of a mineral flotation process, died Dec. 12, 1954.

John W. Magnuson, 77, founder of Western Feldspar Mining Co. and M&S Inc., a mining firm, died at his home in Denver.

Paul H. Van Hoven, retired president of the Duluth Missabe & Iron Range Railway, Duluth, died Dec. 3 in Del Ray Beach, Fla.

Wallace P. Welbanks, 86, former chief draftsman for Oliver Iron Mining, died Nov. 25, 1954. Employed by the firm for 30 yr, he retired in 1937.

O. J. Carlson, 54, assistant state mining engineer and assistant chief inspector for mines, Queensland, Australia, died in Brisbane on Sept. 10, 1954.

William C. Frye, 77, former president of Chain Belt Co., Milwaukee, Wis., died Nov. 16, 1954.

A. E. Moynahan, 78, mining engineer and former assayer at the U.S. Mint at Denver, died in that city recently.

Charles N. Miller, prominent western mine operator, died in San Diego, Calif.

James E. Skane, 63, engineer and executive of Manhattan Rubber division, Raybestos-Manhattan, Inc., died at Clifton, N. J., on Dec. 15, 1954.

Duncan W. Fraser, 79, president and chairman of the American Locomotive Co., passed away Dec. 20 at New York City.

APPRECIATION

Swain Joseph Swainson

Surprisingly often in recent weeks, some problem in mineral dressing has come before some member of this staff, and in answer to it I have caught myself, again and again, about to say, "Why don't you call Joe Swainson up at Stamford and ask him?"

It is hard, you see, to accustom oneself to the idea that Joe is beyond calling, and that his cheerful advice and huge fund of knowledge will no longer be available to us.

Almost as soon as I became settled on the staff of *E&MJ*, I found that Joe Swainson not only could help in my editorial job, he was genuinely glad to. At least once each year, I would spend a day at Stamford talking with Joe, reviewing the events of the past year, lunching together, comparing ideas on everything from flotation to the industry's future.

As a mill man, Joe was one of the best. He directed the mineral dressing division of the American Cyanamid Co., and in that capacity contributed strongly to the advancement not only of his company but to the whole mining industry. The Cyanamid "Aerofloat" reagents were developed and marketed during his service with the company, and he was largely responsible for the widespread use of Heavy Media Separation.

He was modest to a fault in his discussion of the work done under his direction. He tried to advance others rather than himself. His integrity and honesty were unquestioned, even in small things, and we never had to check or to doubt a statement Joe gave us for publication.

Joe graduated from the University of North Dakota in 1924 and took a Master's Degree from Utah in 1925. Since then, his career took him steadily higher year by year in his service to his industry and in the esteem of his friends.

He took an active interest in AIME affairs. He was one of those most instrumental in forming the Minerals Beneficiation Division, and he eventually served as its chairman. Despite the increasingly poor state of his health in recent years, he never slackened in his efforts to do the kind of job he thought ought to be done for his company and his professional society.

He was a good friend and an intelligent, considerate co-worker. Soft-spoken, seldom angry, thoughtful, and courteous, Joe Swainson in his professional and private life was, and is, an example for all of us.

R. H. Ramsey

How an Arizona clay pit handles a lot of "dead" material **fast**

Two CAT* DW20s with No. 20 Scrapers are key machines on this job, which involves stripping 160,000 cu. yds. of blow sand a month from a deposit of Bentonite clay located six miles east of Sanders, Arizona. These rigs, which are among seven Caterpillar tractor-scraper units owned by McCarrell and Grimes, load 19 yards in 40 seconds and spread in 12 seconds. That's fast production in "dead" material—a real test of tractor and scraper performance—and it enables the firm to mine and ship 50 carloads of Bentonite per week.

G. K. Grimes, co-owner of the firm, says, "Our DW20s have plenty of power, are easy to handle, and move a lot of this blow sand fast." The husky Cat Diesel in the DW20 is carefully matched to the tractor and to scraper capacity for easy handling and long life. Oversize tires give excellent flotation and traction on wet surfaces and uneven terrain.

The DW20's teammate, the No. 20 Scraper, has a heaped capacity of 20 yards, with sideboards, 23 yards. This big load is cradled low for stability. Clean, top-of-bowl design gives good operator visibility and makes the scraper an easy target for shovel loading. The No. 20 loads fast, with a live, boiling action. Ejection is positive and even, thanks to the 'dozer-type ejector. Controls are simple yet precise, with no complicated mechanism to get out of order.

Here's what it means to you: fast cycle times, long work life, no need to pamper your equipment. Your Caterpillar Dealer—who provides fast service and genuine factory parts—will be glad to demonstrate the tractor-scraper team that will give *high production at low cost* on your operation. Call him today.

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WASHINGTON IMPACT

Morton A. Reichek, McGraw-Hill Washington News Bureau

EPS Asks Time on Manganese Pilot Plant; Titanium "Second Round" Postponed

CONSTRUCTION OF A FULL-SCALE PLANT by the Government for beneficiating or up-grading low-grade manganese ores and slags should not be undertaken until mid-1956. That's the recommendation of manganese experts of the GSA's Emergency Procurement Service.

Since the end of hostilities in Korea, the EPS, which was charged with finding means of extracting manganese from low-grade ores and slags in the United States for emergency use, has been looking for the most economical and workable process. Operators of current experimental pilot plants around the country have indicated that they may need another 18 to 20 months before their results will be sufficiently known to be evaluated. Based on this, the EPS has asked for a hold-off policy.

Experiments are being conducted principally on the Aroostook County, Maine, ores, open-hearth slags, and manganiferous iron ores in the Cuyuna Iron Range, Minn. Government stockpiles in El Paso, Deming, N. M., Wenden, Ariz, Butte - Philipsburg, Mont., Artillery Peak, N. M., and low-grade ores in the Arkansas and Virginia-Tennessee-Alabama regions are also being studied.

One project has been completed by Southwestern Engineering Co., using flotation processes alone. It recommended that ores from Maine, Arizona, New Mexico, Virginia, Arkansas, and Tennessee be subjected to chemical leaching, since flotation was unsatisfactory by itself.

Manganese Chemical Corp.'s plant at Riverton, Minn., has reported preliminary satisfactory results from ores in the Cuyuna Range by roasting and leaching with an ammonia solution and carbon dioxide gas. It produces manganese carbonate.

Nossen Laboratories in Paterson, N. J., testing Aroostook County ores has found that a reducing roast with a nitric acid dissolving solution, followed by heat decomposition, produces a solid that can be ground and washed into a manganese dioxide concentrate. Apparently technically sound, no information is yet certain as to its economic feasibility.

The L. W. King plant in Salem, Ohio, testing low-grade Tennessee ores, uses a roasting and leaching process, using hydrochloric acid.

Mangaslag, Inc., has built a pilot plant at Pittston, Pa., to test open-hearth slags and Aroostook ores. It uses reduction in a vertical blast furnace to produce a spiegeleisen, followed by selective oxidation of the molten mass to produce a cinder containing manganese. The cinder is further reduced by a blast furnace to produce ferromanganese. Operational difficulties may force Mangaslag to quit the project, and then the Government may be seeking another group to take over the experiment.

Bruce Williams Laboratory of Joplin, Mo., will study extracting a high-grade manganese dioxide concentrate from any low-grade slag or ore. The process involves roasting followed by leaching and precipitation. The novel use of reagents is its principal variation from other roasting-leaching processes.

Diamond Alkali Co.'s process, called the "Sylvester Process," will be conducted at Painesville, Ohio, using Aroostook ores. Ore will be roasted to produce a product amenable to magnetic separation.

Bureau of Mines has conducted tests at Deming, N. M., and Butte, Mont., involving flotation-separation by oil-emulsion. Results were fair, and costs were prohibitive.

Titanium Expansion

AN UNEXPECTED LOW in military consumption during 1954-55 has prompted the Government to put off another round of titanium expansion. Present capacity of 30,000 tons a year was to have been increased to 50,000 tons a year by 1958.

Contractors used only 1,200 tons in 1954, although production reached 5,000 tons. Before agreeing to aid titanium-producers in boosting their capacities again, defense planners are studying why military use of titanium has fallen. Three reasons have been uncovered so far:

1. Serious cracking and embrittlement problems of titanium alloys plague consumers. Pratt & Whitney's J-57 engine production program was hindered by this. Pratt & Whitney is the nation's biggest titanium user.

2. A lack of uniform quality in titanium sponge and alloys causes numerous engineering headaches.

3. High costs—an old problem—remain, even with a 20% price drop in 1954.

Many experts claim titanium is over-rated. For instance, the aluminum industry has come up with a lighter mortar base plate than was anticipated by the military for titanium one; light weight steel alloys are working satisfactorily in supersonic jets; titanium is not a consistent metal under heat generated in flight exceeding "Mach One" (the sonic barrier, averaging around 750 mph).

A new Du Pont plant will soon be established for 7,500 tons annually at Waverly, Tenn. This will complete the 30,000 ton current quota. In addition, current production is as follows: Du Pont 3,600 tons; Titanium Metals Corp., 3,600 tons; Crane Co., 6,000; Dow Chemical Co., 1,800; Union Carbide and Carbon Corp. 7,500.

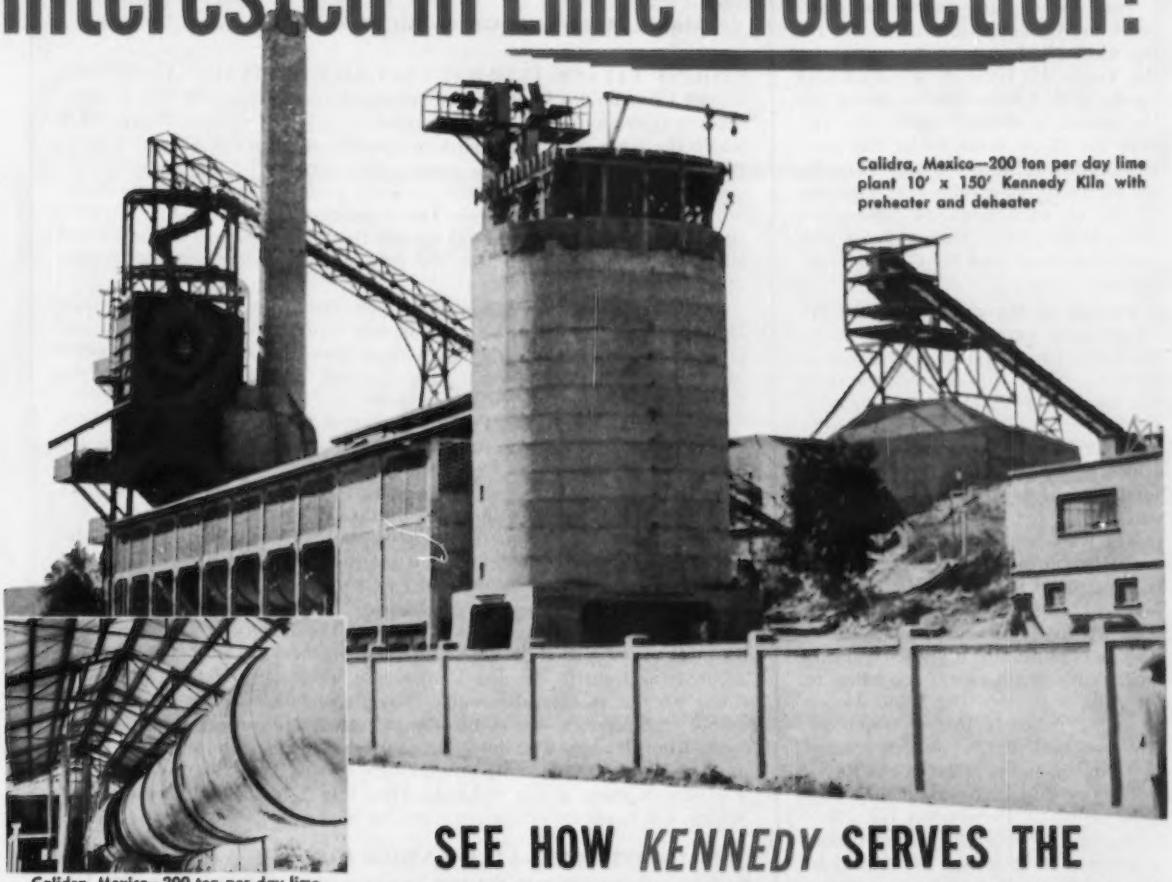
GSA is considering another plant for Titanium Metals for 4,000 tons; and one for Harvey Machine Co. for 6,000 tons. A loan to Monsanto Chemical Co. is also to be considered by GSA. Such a loan was recently made to Horizons Metal Co. An idle magnesium plant was also leased to Western Pyromet Co. for pilot work.

Other firms figuring in GSA negotiations include Kennecott Copper Co., Kaiser Aluminum Co., New Jersey Zinc Co., National Distillers Products, Inc., Glidden Chemical Co., Anaconda Copper Co., and Eagle-Picher Company.

Apparently, said one Government official, most big companies are dragging their feet, unwilling to invest large sums of money in an uncertain market. No commercial market has yet developed, and the military one is feeble at present.

Eisenhower's Foreign Trade Bill started moving through Congress this week. The pace of the hearings indicated rapid passage. Note this too: Administration witnesses are speaking with one voice this year in support of reciprocal trade. That reflects Eisenhower's firmer control over his Cabinet and over foreign policy. Last year a number of Administration spokes-

Interested in Lime Production?



Calidra, Mexico—200 ton per day lime plant 10′ x 150′ Kennedy Kiln with preheater and deheater

Calidra, Mexico—200 ton per day lime plant 10′ x 150′ Kennedy Kiln with oil pre-heating coils looking towards firing end

Calidra, Mexico—200 ton per day lime plant 10′ x 150′ Kennedy Kiln with oil burner

Calidra, Mexico—200 ton per day lime plant 10′ x 150′ Kennedy Kiln with preheater and deheater

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men sniped at the lower tariff policy under questioning by Congressional committees.

Add Democratic control of Congress to Administration solidarity on the tariff front and quick passage of the Trade Bill becomes a virtual certainty. The Administration would get the power to cut all tariffs 5% per year for three years under the proposed measure. It also could cut tariffs on products being imported into the U. S. in only negligible quantities 50% below 1945 levels, and could lower any tariff to a 50% ad valorem ceiling.

Passage of the Trade Act isn't the whole tariff story though. Protectionists have virtually conceded passage in advance. They will concentrate their fire on killing off U. S. participation in the General Agreement on Tariffs and Trade—the international body which has sponsored tariff cutting and international trading rules since the war.

The whole reciprocal trade program could be stalled indefinitely if GATT is rejected by Congress. The limits of bilateral tariff swapping has just about been reached. Some multilateral tariff trading organization is needed to bring tariff down much more, according to the Administration. The White House is saying privately that it won't use any new tariff cutting power granted by Congress unless it gets GATT too.

The new International Finance Corporation which Eisenhower has asked Congress to approve may funnel some investment dollars into overseas mining operations. It would make equity type loans abroad without Government guarantee to private companies abroad. Initial capitalization will be $100-million, the U. S. share $35-million. Congress is for it.

Specific legislation to limit imports of lead and zinc or other metals is out for this session. The Administration is opposed and Congress doesn't want to start legislating controls on individual imports for fear of setting a precedent. Some bills will be introduced to slap quotas on lead and zinc but won't reach the floor of Congress. Take the talk about swapping U. S. surplus butter for Russian manganese with a grain of salt. It could happen. But there are no solid deals in the offing now. The Administration hasn't finally decided whether it dares to make the swap. It's leery of the housewives' reaction to letting the Russians have taxpayers' butter at less than U. S. market prices, Sen. Knowland and other senators favoring a tough cold war policy are fighting the proposal. They argue that any trade with Russia is an opening wedge for appeasement. It's not certain the Russions would do business either.

LABOR THIS MONTH

Alan E. Adams, McGraw-Hill Washington News Bureau

UNIONS ATTACK FEDERAL SECURITY SYSTEM: Top anti-Communist labor unions have opened an assault on Government and industry security operations. The new drive ends a period of comparative quiet in which the labor groups accepted dismissals and firings of alleged security risks. That they're now up in arms is demonstrated by these actions:

- CIO Auto Workers executive council protested the security discharge of a member to Top Defense Department officials, including Defense Secretary Wilson. They charged he was fired from his post at the Detroit arsenal without a hearing after the Army Board first reversed a decision that cleared him.

In a personal visit to Wilson's Pentagon offices, the union team accused Defense of using a security system replete with "stupidities, injustices and cruelties." They claimed the UAW man was convicted of an "isolated incident" while his 12-year Army record, including service in the Korean War was not taken into account.

- The CIO Electrical Workers protested the General Electric Co.'s system of suspending, and then discharging workers who invoke the Fifth Amendment before Congressional hearings to avoid testifying. In another move, the left-wing Independent Electrical Workers Union took GE to court on the issue and lost.

Court ruled that a company had authority to discharge those who invoke constitutional protection. But the issue isn't settled yet; the Union plans to carry the fight to the Supreme Court.

- Engineers and Scientists of America, a union of professional engineers, joined in a Supreme Court test of the Federal Security System. ESA attorneys argued that the system was illegal because it denied the accused the right to meet and cross-examine accusers. The high court's ruling on this is several months away. Remember—these are anti-Red unions: the protests, except for the Independent Electrical Union, come from labor leaders who have demonstrated their feelings about Communism. They are objecting to a security system they believe can convict a worker without a fair hearing. Also, this fight isn't confined to the unions. Other public officials are joining in.

COMMUNIST-DOMINATED UNIONS JOIN THE ATTACK: It's important to keep separate the two moves against security measures. The Independent Mine-Mill and Smelter Workers Union, for instance, is making a hard fight to avoid conviction of Maurice Travis. Travis, secretary-treasurer of MMSW, has been indicted for filing a false non-Communist oath and the union is using all its energies and funds to prevent his going to jail.

It's likely, because of the drawn-out Travis hearings in Denver, the MMSW official won't go to trial until next year. The union strategy is to prolong the issue. But this differs from the positions of right-wing unions who favor a hearing for suspended security risks, just as Travis is having his day in court.

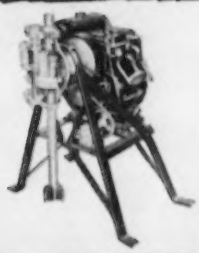
MINE-MILL'S YEAR OF DECISION: Before this year runs out, the fate of the left-wing MMSW leadership may be settled once and for all. It's possible too that its future as an independent organization will be determined. Here's why:

- Next month, Mine-Mill holds its first convention in 18 months. This will be the scene of politicking by present officers who want to be returned to their posts in a union referendum to be held in June. At present it appears that most officials will be re-elected with the exception of Travis. He won over strong opposition last time but his indictment for Red affiliations may defeat him. This would hurt other Mine-Mill leaders.
- The AFL and CIO may complete merger this year. Should this happen, Mine-Mill will make a strong pitch to team up. There's a growing feeling among its officers that it can't continue as an independent and if the union doesn't join up, it'll be open to strong membership raids.

However, there's no chance that Mine-Mill will be accepted under its present set-up. AFL-CIO officers will insist that the membership purge its leaders. If this becomes evident to Mine-Mill members it could affect the summer elections.

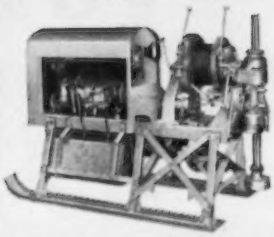
BBS-1

World's best known surface drill. Handles "E" rods to 1000 ft. "A" to 800 ft.



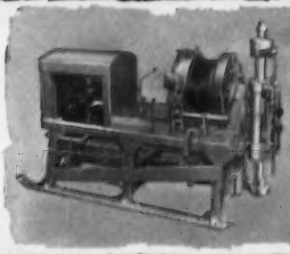
X-RAY

Compact, portable - - 185 lbs. net. Takes ¾" core to 200 ft. Low fuel consumption.



BBS-2

Versatile, choice of 5 swivelheads. Depths to 2400 ft. Gas or diesel.



BBS-4

Drills to 5000 ft. with "B" rods. Moves under own power. Gas or diesel.

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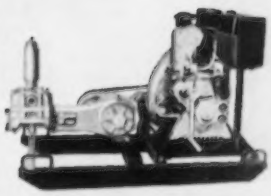
(Powdered metal). All standard sizes available from stock. Also reaming shells, etc.



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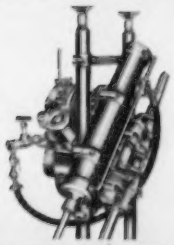
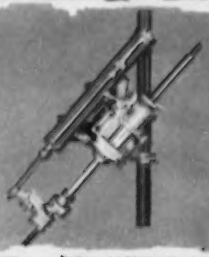
5-12 and 4-7 models. Capacities 400 to 1200 g.p.h. Diesel motor optional on 5-12.



BBU-2

Rugged. Capacity, 1800 ft. with "E" rods, 1400 with "A". Four gear feeds.



J.V.

4 feed swivelhead. Capacity 800 ft. with "E" rods. JVR with reverse and righthand feed screw for blast-holes.

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TOQUEPALA (looking west) is said to be one of the 10 largest copper deposits in the world. White lines in center are roads built to facilitate exploratory drilling. Road to Ilo is in upper center. Road to Quellaveco is in upper right.

THIS MONTH IN MINING

TOQUEPALA (western flank shown above), Quellaveco and Cuajone are on western Andean slope, 10,000-11,000 ft above sea level.

Four U. S. Firms Complete Preliminary Steps To Jointly Develop Vast Peru Copper Property

FOUR U. S. MINING GIANTS, led by American Smelting and Refining Co., have completed preliminary negotiations to join forces in southern Peru to develop three porphyry-type properties which together form one of the world's largest bodies of copper reserves.

In addition to Asarco, the other firms are Cerro de Pasco Corp., Phelps Dodge Corp. and Newmont Mining Corp.

Combined reserves of the three properties, Toquepala, Quellaveco and Cuajone, are said to amount to at least 1-billion tons of ore, averaging about 1% copper.

Under terms of the preliminary negotiations just completed, the Toquepala property, together with Asarco's Quellaveco property and the Cuajone property of Cerro de Pasco and Newmont, will be transferred to a new firm, Southern Peru Copper Corp. In this new corporation, Asarco will own 57¾% of the capital stock, Cerro de Pasco, 16%, Newmont 10¼% and Phelps Dodge, 16%.

All three copper properties are on the western flank of the Andes and are 10,000 to 11,000 ft above sea level. About five years and a total investment of some $200-million will be needed to bring into production Toquepala, the first property to be developed.

Drilling at Toquepala was completed in 1952. Asarco said that an ore reserve in excess of 400-million tons was proven, which has an average assay slightly greater than 1% copper.

The Toquepala project includes preparation of the deposit for open pit mining at the rate of 30,000 tpd, construction of a concentrating mill, townsite and other facilities near the mine, building of a standard gage 110-mi railroad linking the mine with the Pacific port of Ilo, construction of a smelter, power plant and townsite on the seacoast near Ilo and the building of port works, warehouses and other facilities at Ilo.

SKETCH MAP of southern Peru.

Export-Import Bank, which last November agreed in principle to extend $100-million in credit to the Southern Peru Copper Corp., said that Toquepala is one of the ten largest copper deposits in the world. It is estimated that about 90-million tons of overburden must be stripped before mining operations begin.

When in production, Toquepala tentatively is scheduled to produce at least 100,000 tons of blister copper annually for the first 10 yr of production: 85,000 annually the following 20 yr then the average of 68,000 tons annually for the remaining 20 yr of its estimated life.

Southern Peru Copper Corp., also last November, entered into an agreement with the Peruvian Government which assured for the Toquepala project stable income tax rates, waiver of import duties, freedom of copper export and freedom of exchange.

Quellaveco is about 14 airmiles and about 24 road-miles from Toquepala. Drilling at Quellaveco has proven about 200-million tons of ore, averaging slightly less than 1% copper. This, too, is expected to be open pit.

Cuajone is about 15 mi north and slightly east of Quellaveco, Cuajone is estimated to have reserves of some 400-million tons averaging around 1% copper. Both open pit and underground mining are planned here.

If and when the project materializes, this would be the largest single foreign or national investment in the mining and industrial history of Peru. Also, while heretofore companies concerned with other metals have banded together to develop mineral resources outside the United States, this would be the first time that U. S. copper mining firms have formally acted in concert to develop huge foreign copper deposits.

Officials of the Asarco subsidiary, Southern Peru Copper Corp., include Richard F. Goodwin, president (Goodwin also is Asarco vice president in charge of mining); Arthur C. Hall, vice president, and Dr. Alfredo Hohagen and Dr. Alfonso Alvarez Calderón, directors.

NEW PHILIPPINE COPPER MINE, with estimated reserves of 35-million tons, will begin production in mid-February. Mill (center) will process 1.05% copper ore.

Toledo Copper Plant to Tap Huge Reserve

LARGEST COPPER MINING OPERATION in the Far East is claimed with the opening of a 4,000-ton concentrating plant of the Atlas Consolidated Mining and Development Corp., located near Toledo, Island of Cebu, in the Philippines.

Col. Andres Soriano, president of Atlas, named the proposed starting date as mid-February. (See news, p. 222.)

The operation at Toledo will utilize a "vast" deposit of copper ore, now estimated at 35-million tons, averaging 1.05% copper. Limits have not been fully established, according to the international industrialist, but he is sure it ranks with the largest in the world.

Ore lies close to the surface and will be mined by open pit. Col. Soriano said 22-ton Euclids would transport the ore to crushing plant and mill. Initial capacity of the 4,000-ton mill is reported at 200 tpd copper concentrate, 250 tpd pyrites and $2,000 worth of gold. Power is generated by a steam plant using local coal.

Approximately one-half of production has already been contracted for by Mitsubishi Metal Mining Co. of Japan and the remainder will be sold to world markets, principally in the U.S., Col. Soriano said.

Plans are almost completed, according to the company president, for a sulphuric acid plant which will use 100 tpd of the pyrites produced by the copper plant. Balance of pyrites will be sold to fertilizer plants in Philippines, Japan, Formosa, or Borneo.

Also planned is a superphosphate plant, scheduled to use 55 tons of the acid per day. Remainder will be used by local industry, which now imports 10,000 tons annually.

Diamond drilling and geological mapping in the past 11 months have proved up 25-million tons positive and 10-million tons probable, with depth and end limits of the orebody still undetermined, said Col. Soriano.

AIME Meets Feb. 13-17 at Conrad Hilton, Chicago

SOME 350 PAPERS WILL BE PRESENTED at the annual convention of the American Institute of Mining and Metallurgical Engineers, to be held Feb. 13-17 at the Hilton Hotel, Chicago.

Highlights for mining men will be the four sessions on mineral economics; three on education; 10 on nonmetallics; eight on metal mining; seven on geology; four on geophysics, 12 on minerals beneficiation, eight on extractive metallurgy, seven on iron and steel and 12 on physical metallurgy.

Other discussions range from open pits to stratified mining, and analytical research to grinding research.

There will be the usual excellent entertainment, capped by a snow festival at Iron Mountain, Mich.

Mining Calendar

AIME, Annual Meeting, Feb. 14-17, Hotel Conrad Hilton, Chicago.

Ninth Western Metal Congress & Exposition, March 28-April 1, Los Angeles.

Canadian Institute of Mining and Metallurgy, Annual Meeting, April 19-21, Royal York Hotel, Toronto.

International Congress for Ore Dressing, May 8-11, at Goslar, (Harz), West Germany. Preceded by annual general meeting of Institution of German Metallurgical and Mining Engineers.

17th National First Aid and Mine Rescue Contest, October 1955, Knoxville, Tenn.

News Highlights

Pilot work on dithionate process by USBM will be reported on within a few months. **Page 156**

Government has extended the life of the manganese ore-buying station at Wenden, Ariz. **Page 158**

International Smelting & Refining Co. has reopened the Darwin lead-zinc-silver mine. **Page 160**

Estimated mineral production of California was down from the total for 1953. **Page 160**

AEC initiates "fringe area" ore-buying program for uranium in the "off Colorado Plateau." **Page 160**

Silver Bell will drive two tunnels at Telluride in line with plans to reopen in the spring. **Page 162**

Some Michigan companies report shipping figures for the past season. **Page 170, 171**

University of Minnesota's 16th Annual Symposium was held in Duluth, operation problems aired. **Page 172**

Minnesota shipping figures were under last year's. **Page 174**

Four Corners Uranium Corp., Denver, has acquired properties of Largo Uranium and General Uranium. **Page 178**

New Mexico's potash production set a new record, but state mine inspector Garcia warned that the peak has been reached. **Page 180**

Chromite shipments to the Grants Pass, Ore. GSA depot have stepped up considerably. **Page 184**

Utah Mining Assn. launched a new public relations program. **Page 188**

Midnight Mines, on the Spokane Indian Reservation, shipped its first carload of uranium. **Page 197**

Value of British Columbia's mineral production was under 1953's. **Page 202**

Big Bend section of B. C.'s Columbia River is shaping up as a leading source of kyanite. **Page 205**

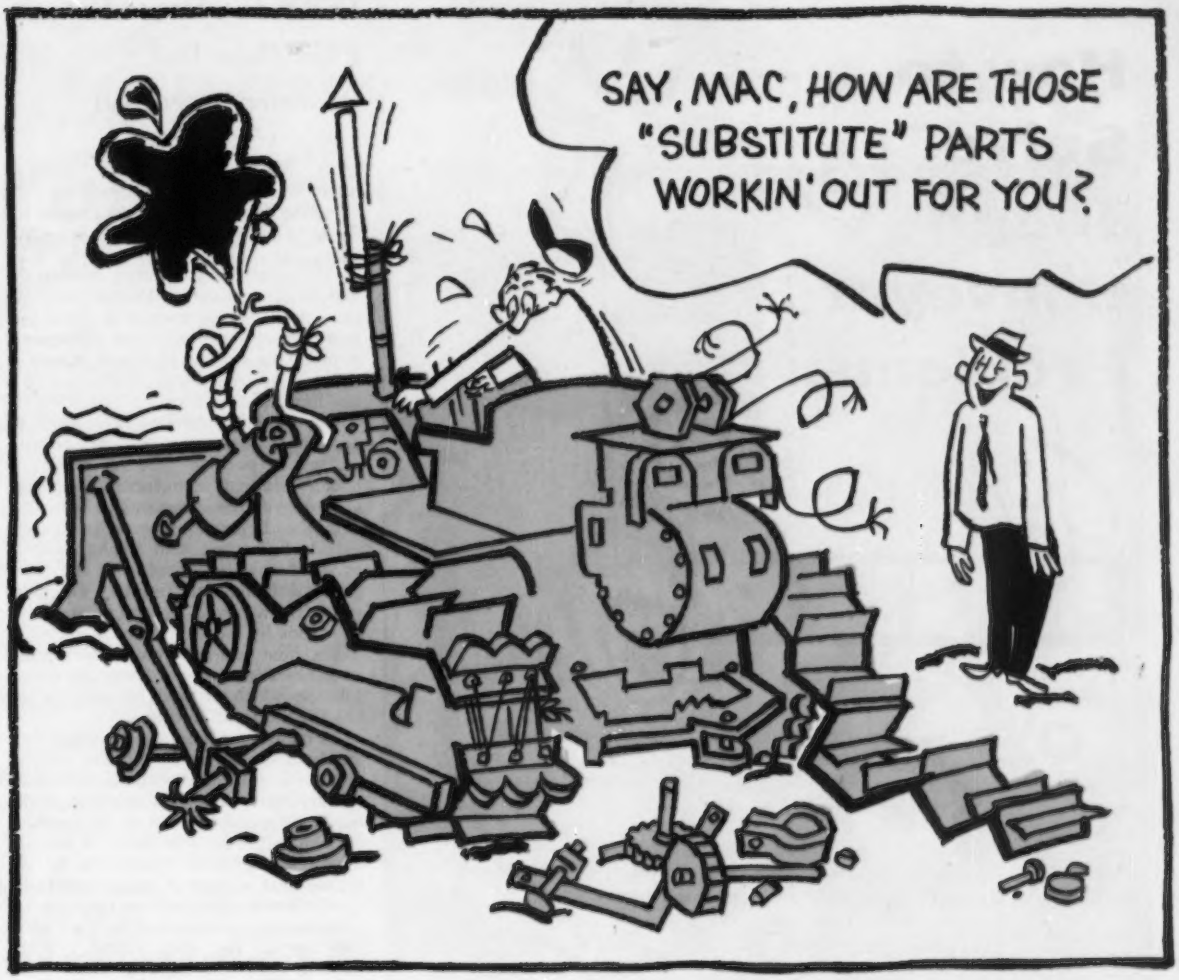
Sali Hochschild, S. A., will soon complete construction of a 20 tpd sulphuric acid plant in Atacama Province, Chile. **Page 208**

Talk of purchase by India of 10,000 tons of sulphur has spurred mining interests in Chile. **Page 212**

Castano Viejo, lead-zinc mine owned by National Lead, will reach full production by late 1956. Machinery is coming from U. S. **Page 214**

French claim revolutionary gold recovery process. **Page 220**

Russia is building up her gold reserves, say reports. **Page 226**



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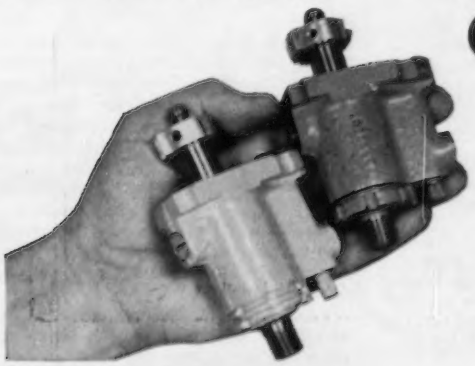

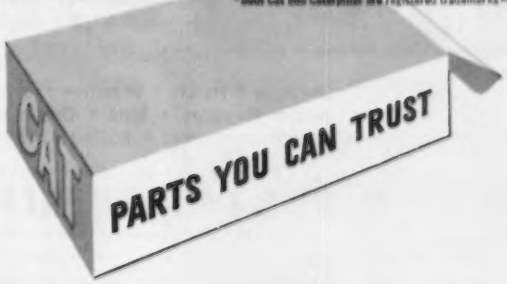

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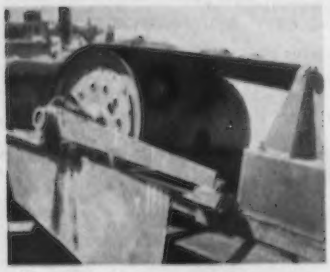

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USBM Dithionate Process Pilot Plant Test Reported Successful

U. S. BUREAU OF MINES station at Boulder City, Nev., has completed pilot plant work on the dithionate process for recovery of manganese from low-grade oxide ores. Pilot plant work was under the direction of Harry Fuller, head of the manganese section at Boulder City. A full report on this process is being prepared by Fuller and Carl Rampacek, head of the Bureau of Mines station at Tucson, Ariz., and will be released in a few months.

The dithionate process will work on any manganese dioxide type of ore, making it possible for the U. S. to obtain essential manganese from large low-grade domestic deposits.

In the dithionate process, manganese dioxide is leached with sulphur dioxide in which manganese sulphate and manganese dithionate are formed. The manganese is removed by precipitating the hydroxide by the use of lime.

The lime acts not only as the precipitant but regenerates calcium dithionate solution which is used for pulping the ore for the leach circuit.

As manganese sulphate is formed during leaching it reacts with the calcium dithionate to form manganese dithionate. At the same time the sulphate is removed from the solution as the insoluble calcium sulphate. This makes it possible to get a high-grade precipitate by the use of lime without it being excessively contaminated with calcium sulphate.

During the operation of the pilot plant 390 tons of ore were treated. While treating an ore containing 9.6% manganese, 90% of the manganese was extracted and a final product containing 60% manganese was produced. Ore from the Artillery Peak deposit in Arizona was used in the pilot plant operation.

Sulphur dioxide was generated by burning pyrite in a fluidized solids reactor. A gas containing 12% sulphur dioxide was used generally. The gas was run into leaching tanks so designed that the impeller had an inspirating effect on the gas while at the same time the gas was brought into intimate contact with particles of ore. The reaction was rapid and the ore went into solution almost instantaneously.

Two pounds sulphur dioxide were required per pound of manganese extracted.

After leaching, the ore pulp was aerated by inspirating air instead of sulphur dioxide. This is necessary for oxidation of sulphites to sulphates. The solution was partly neutralized by the use of lime in order to make it less corrosive and to precipitate impurities.

The filterability of the precipitated manganese hydroxide was greatly improved by controlling the conditions of precipitation.

Lime required for precipitation was about one pound of calcium oxide per pound of manganese precipitated.

How to keep crawler parts operating longer

Replacing worn shovel parts is costly ...for example, the sprocket, tumbler and track assembly illustrated, which represents a considerable outlay.

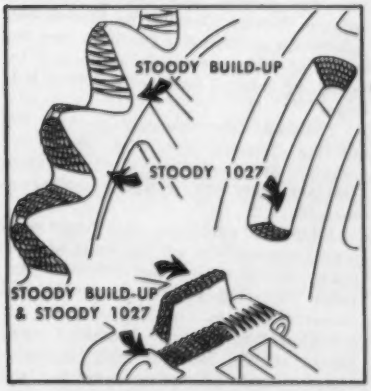
The experience of a large pipeline company operating in the West, provides a good example of maintenance procedures that cut replacement costs and save lost equipment time. Two sets of sprockets, tumblers and tracks are maintained for each backhoe. The spare set is rebuilt and hard-faced on regular shop time. It is ready for instant use when needed. When the track shows signs of slipping, the rebuilt equipment is sent out, worn parts are removed and the spares installed on location.

NUMEROUS ADVANTAGES

Work schedules in the welding department are thus smoothed out, since rebuilding and hard-facing jobs can be used as "time fillers" at the welder's convenience without overtime costs.

Shovel down-time is reduced. Only enough time is lost to pull worn assemblies and substitute the spares. Shovels are immediately put back on the job.

Although no exact record is available, careful observation over a long period of time indicates an almost indefinite increase in service life for these specific parts. The procedure has proved so successful it is now adopted as standard practice.



REBUILDING & HARD-FACING PROCEDURES

Wear patterns are the key to the most effective use of hard-facing. Worn areas of sprocket teeth, lugs and tumblers are rebuilt to within $\frac{3}{16}$" of final size with Stoody BUILD-UP, which provides a rigid base to properly support the hard-facing alloy. A final pass of Stoody 1027 supplies good wear resistance with high impact strength. These same alloys are used on the pads to restore size and renew life.

These and other hard-facing applications are fully described in the Stoody Guidebook. Ask your Stoody dealer or write for a free copy.

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* Here's a new bulletin you should have—on cleaning, dewatering, classifying sand and other coarse or fine materials—with McLanahan Single or Double Screw Washers. Complete details on models, capacities, screw sizes, etc., available. Write for your copy today!

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PIT, MINE AND QUARRY EQUIPMENT HEADQUARTERS SINCE 1835

IN THE U.S.

ALASKA

Admiralty Alaska Gold Mining Co. has purchased a Longyear Wolverine diamond drill with an electric drive and a gas-driven 20 KW generator to furnish the power. This is equipment for the next phase of their diamond drilling program on their nickel-copper ore body at Funter Bay. The prospect drifting is continuing. Activities of this company also include the staking of additional claims as a result of the aerial magnetometer survey made over the area last summer.

Alaska Copper Mines Company exploration project at Maclaren River has closed down for the winter. Although large quantities of copper ore of commercial value have not yet been found, they intend to resume work at the earliest possible date in the spring.

Well-known Canadian mining group has reportedly taken an option from the De-Coursey Mountain Mining Co. on their mercury holdings along the lower Kuskokwim River. They are planning an exploration program before putting the properties into production. The group's serious intentions are indicated by the fact that they are also reported to be picking up other mercury prospects in the Kuskokwim Valley.

ARIZONA

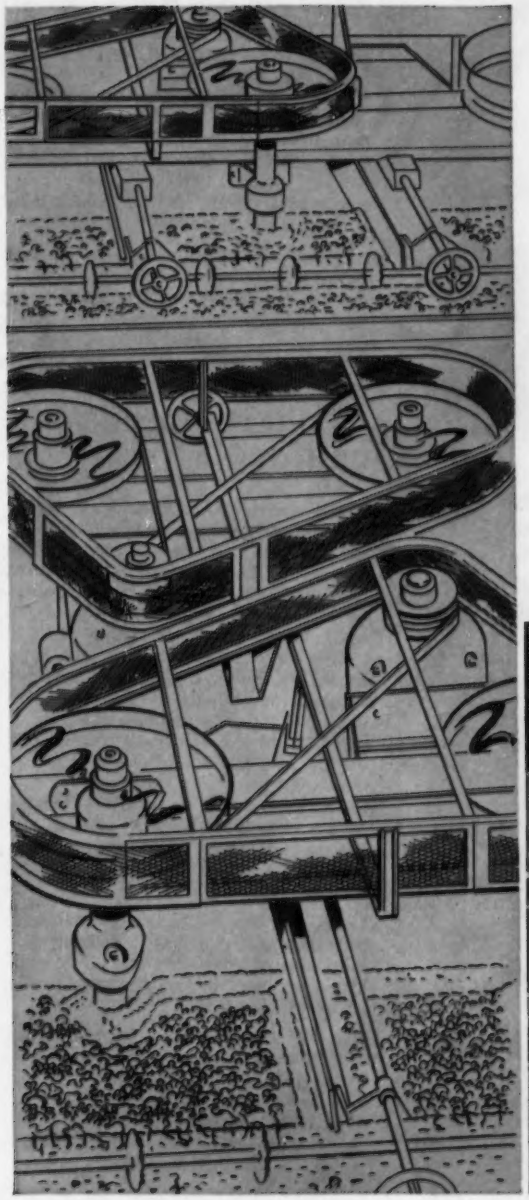
"Substantial channel of carnotite" ore has been discovered in northern Apache County by Spencer Uranium Co., Salt Lake City.

The find, near VCA's open pit Monument No. 2 is in Spencer's Yazzia mine. O. W. Bunker and Edward M. Mabey, Salt Lake officers of the firm, said, "Overburden has been stripped revealing a channel in the Shinarump about 150 ft wide and, at present, 1,000 ft long. long. Ore is indicated in depths up to 10 ft, while pods and lenses of the uranium-vanadium material show radiometric readings in excess of 10% U_3O_8 in places."

New life for Arizona's manganese industry was granted with Federal extension of the Wenden Ore Buying Station program. An additional 1.2-million long ton units of manganese was authorized beyond the original quota of 6-million long tons.

The new allotment will prolong life of the Wenden operation about five months. Shipments have been averaging 300,000 units of contained manganese monthly.

Additional purchases were based on a new interpretation of the original purchase directive—on the difference between contained units of manganese and recoverable units. The original called for 6-million long tons of contained manganese on the basis of 80% recovery. The extension directive calls for the



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Dow Xanthate Z-11, as recommended by our Mining Technical Service, can give you better metallurgy at lower cost

Get rid of those complex collector combinations, by replacing them with Dow's new Xanthate Z®-11 and proper pulp conditioners, with the help of our Mining Technical Service group. You can actually *reduce* collector consumption while *increasing* metal recovery.

This sodium isopropyl Xanthate is a powerful general purpose collector for improved flotation of all sulfides including pyrite. Since Xanthate Z-11 is substantially nonfrothing, it makes possible more exact, independent control of collector and frother.

And if excessive frother consumption has you worried, Dowfroth® 250 can cut that cost by 50%—has done even better than that in some mill operations while producing improved metallurgy.

For many years, Dow has helped promote flotation economy through research. For consideration of your problem, or samples of dependable Dow reagents, write to THE DOW CHEMICAL COMPANY, Midland, Michigan, Dept. OC 815H.

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Because of the unexpectedly long life of SuperDuty DIAGONAL DECK Concentrating Tables, it is the experience of users that the net cost of their mineral concentration reduces year to year just about the time most aged equipment costs more to keep going.

Depreciation schedules run out long before the useful life of these tables and, due to proven low maintenance for retention of their full efficiency, what starts out as a sound investment for you continues for many years as a sure-fire means of profiting by "beating the mortality rate".

You will want complete data and the case experience of satisfied operators. Send for Bulletin 118-B.

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This all steel Constriction Plate Classifier is available in 1 to 10 or more cells. Novel secondary classification sharpens the separations made by each main cell. Advantages offered are: (1) Sharp separation, (2) accurate classification, (3) easy and effective hydraulic water regulation, (4) as many spigot products as there are cells, (5) continuous discharge, (6) no moving parts, (7) low maintenance cost.

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Arizona (*Continued*)

depot to continue until it has stockpiled 6-million long tons of recoverable manganese.

Originally, the Wenden depot was to operate until July 1, 1958. But unprecedented mining in Mohave and other Western Arizona counties accelerated the build-up. About 1,000 men have been employed at 50 different Arizona mines in the past two years supplying the depot.

AEC has asked lease of 40 acres of San Carlos Apache Indian land in east central Arizona for establishment of a uranium buying station and possibly a mill. First plans are for a 10-man force developing a flow of 1,000 tons of ore a day. Plans call for subsequent erection of a 200-ton mill.

CALIFORNIA

A Los Angeles TV transmitter engineer who considers mining a spare time project has been given credit for shipping the first uranium ore from California.

His truckload (1300 lb) of ore, hauled from the mine to the nearest road by pack, started for the Vitro mill in Salt Lake City on July 14, 1954—17 days before Miracle Springs Mining Co.'s first shipment of uranium by rail, hailed at that time as California's first shipment.

Origin of the first truckload of ore was the Mindte group of claims near San Bernardino on Bear Lake. Nine original claims were located by Robert A. Mindte of Los Angeles, who now holds them. His relatives hold claims on 600-800 surrounding acres. Major claim in the Mindte group is the Thumbum.

Frank A. Wardlaw, Jr., general manager of International Smelting & Refining Co., subsidiary of Anaconda Copper Mining Co., announced reopening of the Darwin lead-silver-zinc mine.

Natomas Co., California gold dredging firm, reports recovery of gold worth $2,787,000 in California and Nevada dredging operations during the year ended Sept. 30. This is under revenues in 1952 (last full year reported), when the amount totaled $2,973,000.

Total estimated production of metallic minerals in the state during 1954 was behind 1953 production, the 1954 total value being $38,246,000 compared with $39,581,360 for the previous year.

Included in the 1954 total are chromite, $2,347,000; copper, $178,000; gold, $8,326,000; iron ore, $8,850,000; lead, $631,000; mercury, $3,102,000; silver, $283,100; tungsten concentrates, $11,360,000; zinc, $288,200, and other metals, $2,880,700. There was a dramatic reduction in value of lead, zinc and silver produced, while value of mercury and tungsten produced increased sharply over 1953.

COLORADO

Atomic Energy Commission has initiated a "fringe area" uranium ore buying pro-

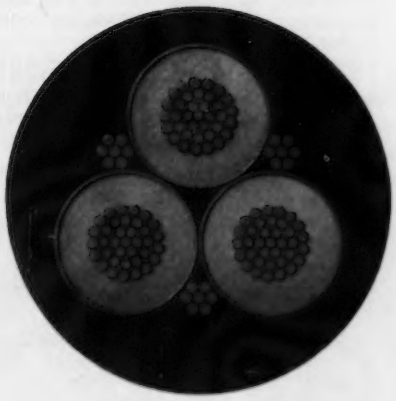
Expose it to sun and heat...

Pull it over rocks and shale...

Trench it in presence of acid water...

Through it all—

Anaconda's tough **MINE POWER CABLE** keeps power flowing



This easy-to-splice cable is built for heavy duty. It saves you money. It handles well. And it lasts longer – with fewer power interruptions, less maintenance trouble.

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BUTYL INSULATION has high dielectric strength . . . superior long-aging characteristics . . . and excellent resistance to moisture, ozone, and heat.

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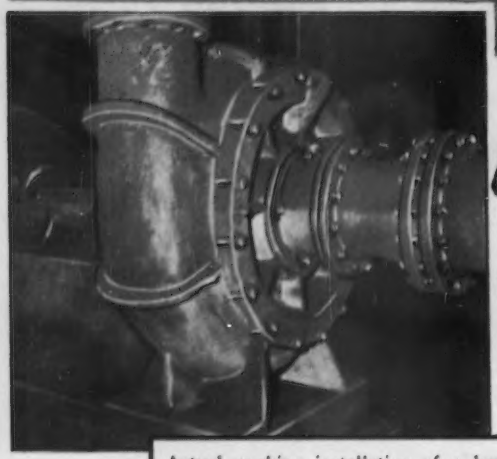

Morris

low-speed wide-clearance SOLIDS PUMP

Actual working installation of a low-speed, wide-clearance Morris Solids Pump which handles fine solids at a rate of 6,000 gpm at 52' total head. Pump speed only 370 rpm, 14" suction opening, 12" discharge.

Where total heads do not exceed about 120 feet, low-speed, wide-clearance Morris Type-M Solids Pumps will handle solids ranging from fine abrasives up to pieces 11" in diameter. The low-speed reduces the abrasive action of the smaller particles, the large clearance allows larger solids and "tramp" pieces to pass without trouble.

Longer Wear, Easier Maintenance

Designed so that the most important wearing parts receive the least wear, initial high mechanical and hydraulic efficiencies are maintained throughout the longer service period of the pump. Double-thick wearing parts are sub-divided and protected so that the greatest erosion is taken by easily replaced segments. That means speedy, easy renewal, less down-time and lower maintenance cost.

Free Consultation

Morris engineers are always available to discuss and study your pumping problems with you. Describe your needs in a letter—or call your nearest Morris office. Our recommendations are free—entail no obligation. Write for Bulletin 175 which describes the Type M Solids Pump in detail.

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MORRIS *Centrifugal Pumps*

Colorado (*Continued*)

gram of "off-Colorado Plateau" ores, it was disclosed in Grand Junction.

There has been no formal announcement of the program by the commission.

According to the Raw Materials Office of the AEC at Grand Junction, contracts to date have been negotiated ones. In general, they provide for payment on haulage account of 6c per ton mile for a distance up to 100 mi, to the nearest rail-head.

From the rail head to nearest or designated stockpile or mill point, the AEC pays the freight without cost to the producer.

To date, the commission has not purchased minimum specification ores as prescribed in its circulars. This is ore containing 10% U_3O_8.

The growing Gas Hills, Fremont County, Wyo., district is not included in the fringe area. And as certain areas grow in production, they are taken out from under the "off-Colorado Plateau" purchase program.

John S. Wise, general manager of Telluride Mines Inc., a subsidiary of Idarado Mining Co., announced plans to revive zinc and lead operations at Telluride. The company closed down last spring. Now the board of directors has authorized expenditures—rumored at $1.5-million—to reconstruct the ore processing plant at Pandora, and press a program of "extensive underground development." Wise estimated that by early 1956 ore production will be at a monthly rate of 30,000 tons.

Although mining operations at the Silver Bell Mines at Telluride are being suspended for the winter, the two tunnels will be driven. This was announced by E. H. Saunders, president and general manager, who was in Telluride recently with A. A. Smith, superintendent of the Silver Bell, and Walt Bronson, superintendent of Four Corners Mining Co.

Silver Bell is retaining a skeleton crew to drive the Badger vein and to the Suffolk Extension Vein. This tunnel is near old Ophir. In the Silver Bell at Ophir Loop the main crosscut tunnel will be extended to develop the gallium ore which has been core drilled.

Golden Cycle Corp. of Cripple Creek is said to have the deepest uranium shaft on the Colorado Plateau. This uranium producer is on the Atkinson Mesa in Montrose County, Colorado.

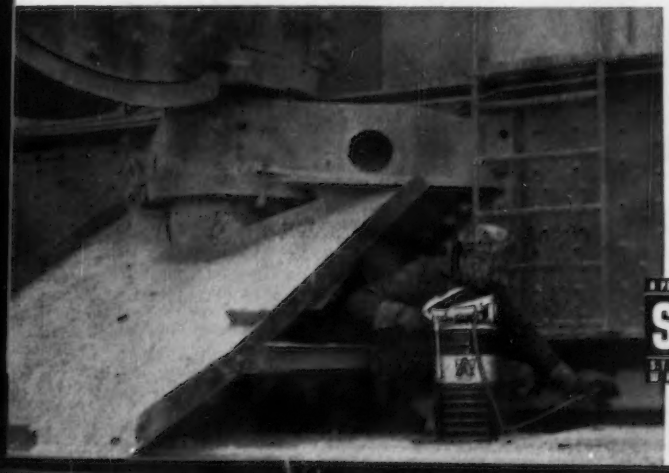
Golden Cycle has an AEC lease of 92 acres and sunk the shaft from the surface to the present depth of 646 ft. Last annual report of the company anticipated a daily production of from 35 to 50 tons of uranium ore from the property at about this time.

Radioactive bones of a dinosaur have been unearthed in a uranium ore strip mine being developed on the Turkey Creek ranch 17 mi southwest of Colorado Springs. Gano Senter of Denver, an official of Dome Uranium Mines, Inc., said approximately 200 lb of the dinosaur bones had been uncovered by bulldozers that have stripped about 50 ft from the top of a hill on the ranch.

• Here the sheaves of a shovel get a shot of clean, new lubricant. Operator is using Alemite Hand Gun 1056-SE. This lever-type gun has plenty of power to push out old grease and dirt—has large capacity to serve many bearings without refilling!

• Alemite Loader Pump 7181-L fills a hand gun quickly—easily. Just eight strokes of the pump fills the gun completely, no mess, no waste, no troublesome air pockets. Lubricant is protected at all times from dirt, dust and grit that can ruin bearings.

• Here the roller track that carries the massive weight of a dragline and takes the tremendous pull from the boom is being lubricated with an Alemite 7137-A "RED-A" Bucket Pump. Pump provides 5,000 pounds pressure for positive lubrication, large capacity.



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"tons-per-hour" figures are the same as cash!

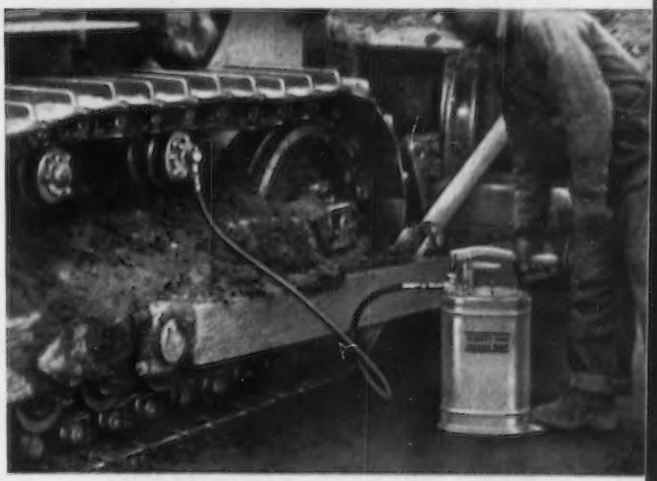
ALEMITE "ON-THE-JOB" LUBRICATION

1. **SAVES TIME!** By bringing clean, fresh lubricant right to the machines—where you need it, when you need it!

2. **BOOSTS TONNAGE!** By cutting expensive downtime for lubrication—increasing output of both men and machines!

3. **SAVES MONEY!** Nowhere are bearings beset by such dangers from grit and abrasion. Here's how to protect them, guard against costly breakdowns!

• The track support rollers of this bulldozer are getting positive lubrication protection from this Alemite 6521-B Tractor Bucket Pump. 35-pound capacity means less time wasted in refilling, and lubricant reaches bearings "refinery clean." Fast—efficient!



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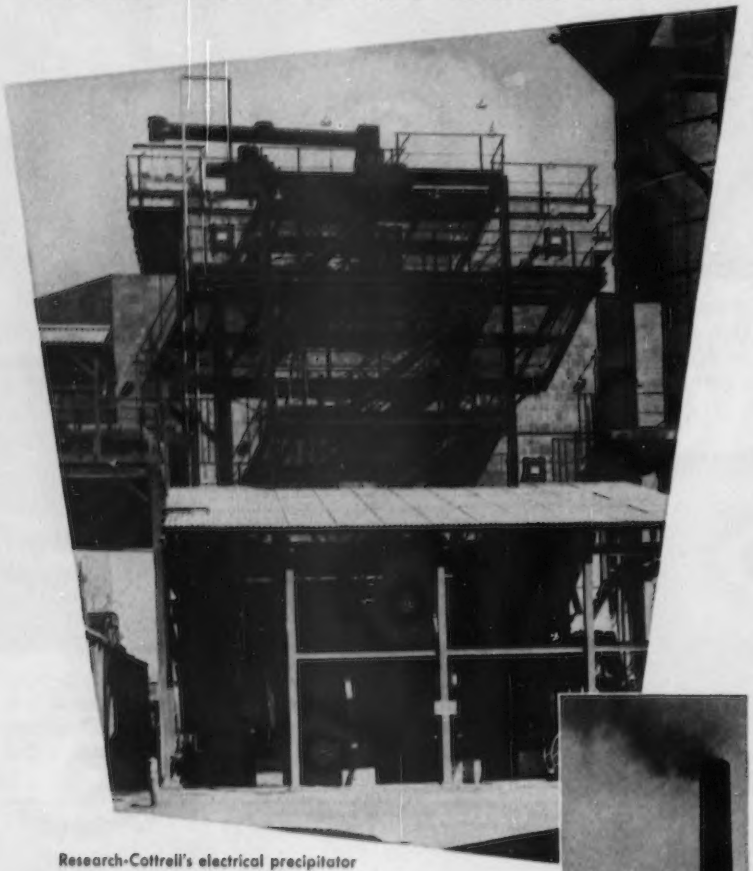
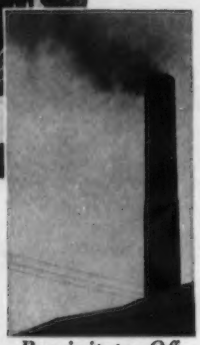
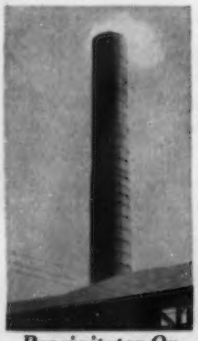


Research-Cottrell's electrical precipitator installation at the Palmerton, Pa. plant.



Precipitator Off



Precipitator On

The two photographs (right) show the results of this Research-Cottrell installation. The smoke in the picture at the top (Precipitator Off) consists of dry dust and fume entrained in the zinc ore sintering machine gases.

The picture at the bottom (Precipitator On) shows nothing but water vapor escaping from the same stack.

If you have a fume problem that involves recovering valuable materials that are going up the stack or combating a smoke nuisance, get in touch with your nearest Research-Cottrell representative. His experience with over 300 roaster and metallurgical precipitators will enable him to advise you on the most effective—and economical solution to your problem.

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Colorado (*Continued*)

A rich strike of ruby-silver ore has been reported near Montezuma by the Burke-Martin Mines Inc. They reopened the old Silver Wing tunnel and were driving toward the Meteor Lode. It is reported that ore from the vein assays as high as 854 oz silver, ½ oz of gold and 8% lead to the ton.

With the ore bins completed, ore is moving from the mine to the A.V. Smelter at Leadville. Burke-Martin mining operation is under the direction of Tom E. Martin who also is vice president of the company.

Dodge Uranium Corp. working a claim at the top of Palisade Mountain above sheer walls 2200 ft high, is shipping ore by helicopter, 400 lb at a time.

The rented whirlybird, using a landing strip not much bigger than the bed of an ore truck, also flew in all tools and equipment, including a 1,300-lb drilling rig and material for a two-bunk shack.

When miners on top of the mountain need a box of dynamite or a heavier sledge, they signal workmen below with a mirror, asking them to get on a portable two-way wireless telephone. Then the men on top give their order, and Pilot Don Williams of Allied Helicopter Service takes off like an elevator operator.

Value of the Palisade Mountain claim—there is only one—still is somewhat uncertain. A strata of rich carnotite, assaying from 3.5 to 15.8% uranium, appears to go through the mountain. If it does, says Jerry Yakes, an officer of the corporation, "we'll have quite a few millions up here."

Ore being taken out now is solely from exploratory work. Palisade Mountain is near Gateway.

Other uranium firms using helicopters include Hidden Splendor Mining Co., subsidiary of the Atlas Corp.; Interstate Mining and Exploration Co., and Western National Co., Ltd.

Bart Stevenson, 55-year-old freshman at the Colorado School of Mines at Golden, has put his studies to practical use.

The middle-aged frosh, who piloted a plane in World War I, reported he had found a commercially profitable vein of uranium ore on the Tom Cavenaugh ranch south of Morrison.

Crescent Uranium Mines, Inc., has reported first shipments of ore from its mine on Outlaw Mesa, 2 mi southwest of Grand Junction.

Howard S. Chamlee, president, said 20,000 tons of uranium ore has been blocked out.

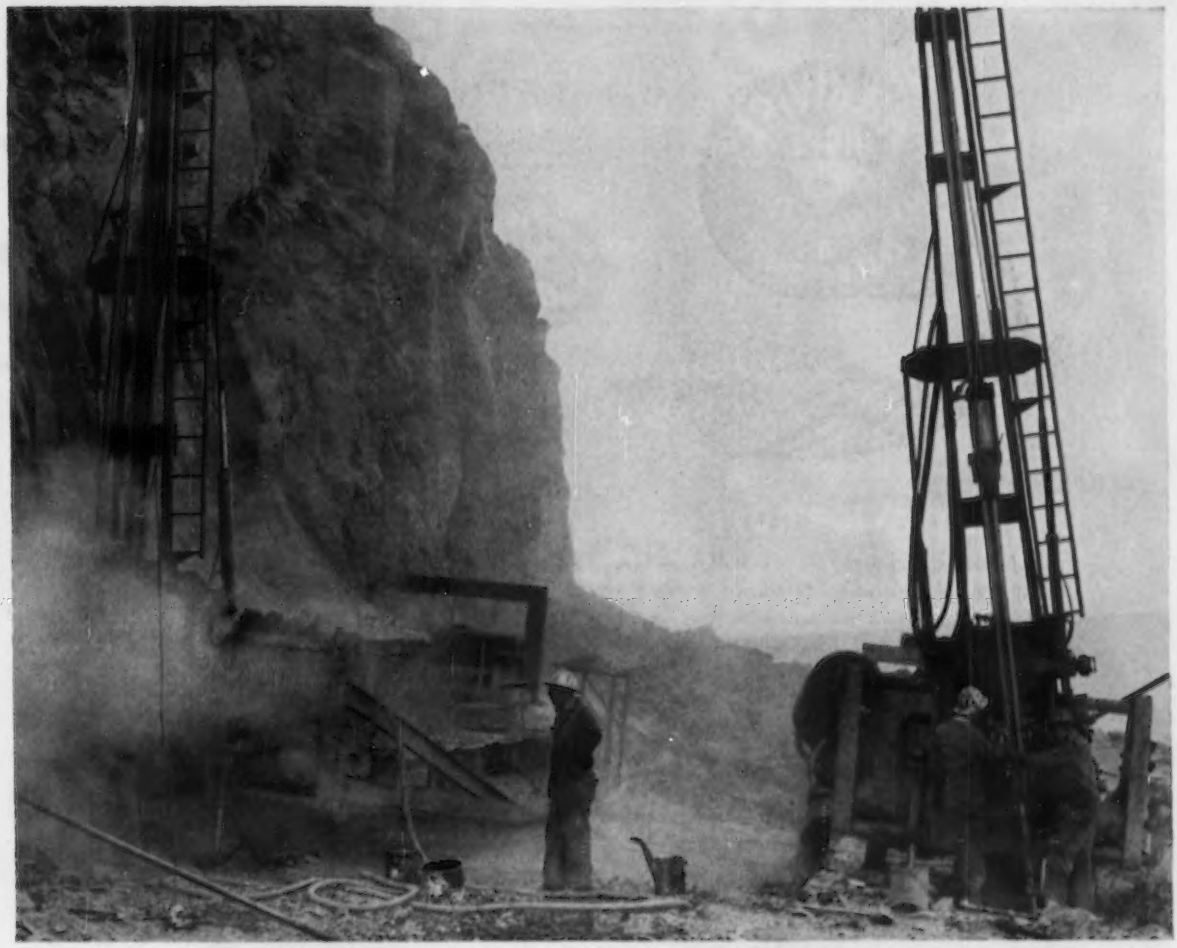
The Crescent claims are farmed out to Consolidated Uranium.

Vernon J. Pick, general manager of Hidden Splendor Mining Corp., was to leave Feb. 1 for Argentina to direct uranium exploration there for the Atlas Corp.

Atlas, under an agreement with the Peron government, is to have full control of all uranium exploration in Argentina.

Pick expected to be gone from his Grand Junction home about a month.

Uncompahgre Uranium, Grand Junction,



This construction photograph, showing Bethlehem 2-in.-round Hollow Drill Steel mounted in drills, emphasizes the rugged rock formations confronting contractors Slate & Hall, Portland, Ore. The drill steel was reconditioned by Westland Equipment, Portland.

Moving 1,272,000 cu yd of Rock for New Highway in Northwest

There's a lot of formidable rock-covered country along the south bank of the Columbia River, east of The Dalles, Oregon. And removing it was no easy task, as drilling crews learned quickly when initiating a contract for the relocation of 7 miles of U. S. Route 30. Biting into the high bluffs to make blast holes up to 100 ft deep, the contractors used 24-ft lengths of 2-in.-round Bethlehem Hollow Drill Steel, fitted with carbide-insert bits.

This contract, part of the gigantic project under the supervision of the Corps of Engineers, Portland District, U. S. Army, is required by the construction of the 8500-ft-long The Dalles Dam. Upon completion of the contract, some 1,272,000 cu yd of very hard and medium-hard Columbia basalt will have been excavated.

Bethlehem 2-in.-round Hollow Drill Steel is an outstanding steel for deep-hole drilling because of its toughness and long service life. Analyzing 0.80 carbon, it is a fatigue-resisting steel with which large bits are used, permitting maximum rock-removal with fewer holes.

It is usually furnished in lengths of 22 ft and 32 ft, and has a ¼-in. centered hole which is both smooth and true. The steel can be easily forged and heat-treated, and has a wide quenching range. It's a good steel to keep in mind whenever deep-rock drilling is scheduled.

BETHLEHEM STEEL COMPANY, BETHLEHEM, PA.

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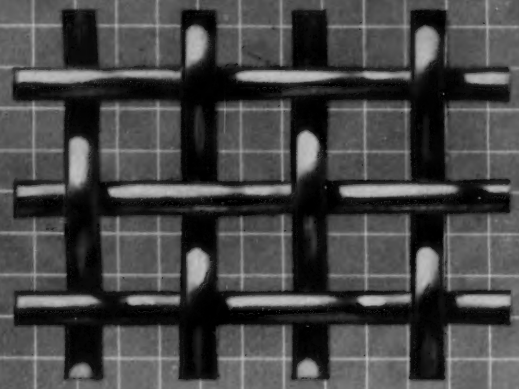
BETHLEHEM STEEL

WICKWIRE ROPE

Known for its dependability for over half a century, Wickwire Rope is carefully controlled throughout manufacture to assure the maximum degree of strength, toughness and fatigue resistance—extremely important features in mining operations where the safety of men and protection of expensive equipment depend upon wire rope.



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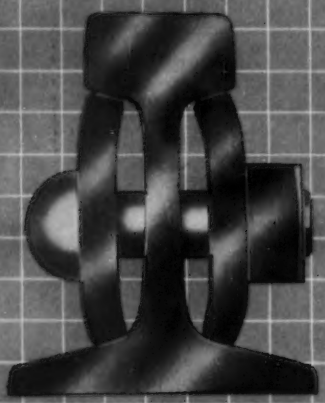
Woven to the most exacting tolerances, Cal-Wic Industrial Screens give unusually long life because they are tightly crimped to prevent hidden wear at the wire intersections. Wires can't work loose under even the most severe vibrations. Wide range of screen types and alloys available.

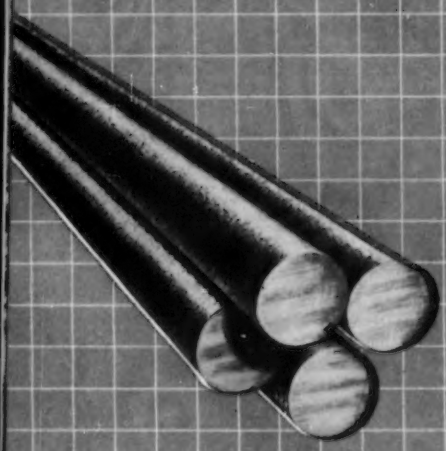
CF&I ROCK BOLTS

Enable progressive mine operators to economize and, at the same time, provide greater safety and better housekeeping in their mines. Available in either slot and wedge or expansion shell with Pettin shell types.



CF&I MINE RAILS AND ACCESSORIES

Available in the range of 12 to 45 pounds, CF&I Mine Rails meet A. R. A. standards. Accessories include splice bars, angle bars, spikes and track bolts and nuts (both square and hexagon).



CF&I GRINDING RODS

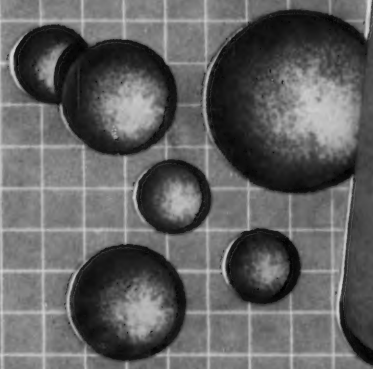
Rolled of special analysis steel, then carefully machine-straightened and cut to hold end taper to a minimum ... increase rod life. Equally effective for fine crushing or coarse grinding.

be sure!

specify proven and dependable

CF&I MINING PRODUCTS

When you specify CF&I Mining Products, you are sure of receiving products that are perfectly designed for mining operations—for the complete line of CF&I Mining Products has been fully field-proven over many years of service and in our own mines. In addition, rigid quality controls give you positive assurance that CF&I Mining Products will provide trouble-free service throughout their long life.



CF&I GRINDING BALLS

Forged of special analysis steel, CF&I Grinding Balls have built-in toughness to give optimum grinding ability and excellent wearability ... provide better power transmission and high impact-resistance.

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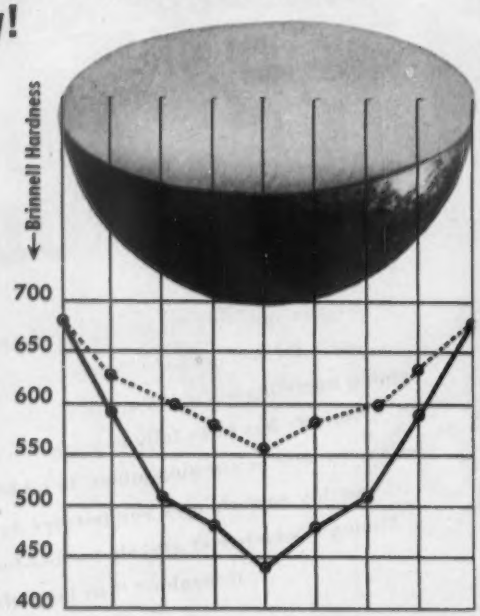
AFCO "IC" (improved carbon) FORGED STEEL GRINDING BALLS

Forged from AFCO's new improved carbon steel, AFCO "IC" deep hardened grinding balls offer deep, penetrating hardness comparable to many types of costly alloy balls—yet they are priced competitively with media forged from ordinary carbon steel.

COMPARE...You'll see why AFCO "IC" Balls are YOUR Best Buy!

Here are hardness curves developed from actual tests on AFCO "IC" deep-hardened 4" ball (solid line), and a 4" alloy ball (dotted line). Note how the AFCO "IC" gives you such alloy-type characteristics as high average volumetric hardness and deep penetration with a "tough" center—at substantial savings in cost.



Cut Grinding Costs NOW—Specify AFCO "IC"

Get Your Grinding Costs Down—
Specify AFCO "IC" deep hardened grinding balls for your mill now!
Available in ¾" to 5" diameters.
For details, prompt quotations, phone, write or wire TODAY.

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AFCO PRODUCTS

Colorado *(Continued)*

reports uncovering of a large uraninite and autenite orebody in the main tunnel of the Highlander mine, 2½ mi north of Idaho Springs, Clear Creek County. John Gaskill, president, says the majority of ore runs 0.15%, with some large pockets assaying as high as 10.0%.

Company is concentrating all ore below 0.20% and shipping high grade direct to Vitro Chemical Co.'s plant at Salt Lake. First shipment of 50 tons of low grade was concentrated at Silver Spruce mill at Idaho Springs. AEC's assay was reported 21.6% U_3O_8.

Operations at Highlander are now on 2-shift basis with production at 30-50 tpd. Future plans will up production to 150 tpd, says Gaskill.

IDAHO

American Smelting and Refining Co.'s new Vulcan-Galena Mine on Lake Gulch, west of Wallace, has started full-scale production after 8 yr of difficult and costly exploration and development.

The project, started in 1947, has developed substantial zones of both lead and silver mineralization on and above the 3,000-ft sea-level horizon, which is 1400 ft below deepest workings of the old Galena Mine.

The lead zone, developed from the 3,000 upward to the 2400 level, contains one or more ore structures mineable over a substantial part of a developed length. The mine's main silver vein is partially opened from the 3400 to the 2400 level and is mineable for lengths ranging upward from 400 ft.

Expansion of the mill to 350 tpd capacity has been completed and regular production is underway.

Nabob Silver-Lead Co. and Merger Mines Corp., both Coeur d'Alene District firms, have entered into a joint venture agreement for exploration and development of a 10-claim uranium prospect in northeastern Utah which has high-grade ore outcropping at the surface and may develop into an open pit operation.

United Uranium Inc. of Boise has started exploratory drilling on a uranium prospect known as the Kim property in Mojave county, Ariz., about 10 mi west of the Pipe Springs National Monument.

Highly radioactive ore containing about 2% copper is reportedly exposed in the Chinle formation where it outcrops down from the ridge on which the claims are located.

Magic Valley Uranium Co. of Hailey has been organized by S. W. Stoker and his two sons, Robert W. and S. William, to develop a 10-claim uranium prospect with favorable ore showings in the Red Canyon area of Utah's Temple Mountain District. The company holds also a state lease on 640 acres in Emery County, Utah, and has a six-claim property in Camas County, Idaho.

Pitchblende, a primary ore of uranium,

GREATER RECOVERY IN THIS KUE-KEN TUNGSTEN PLANT

① Grizzly

② Kue-Ken Jaw Crusher

③ Screen

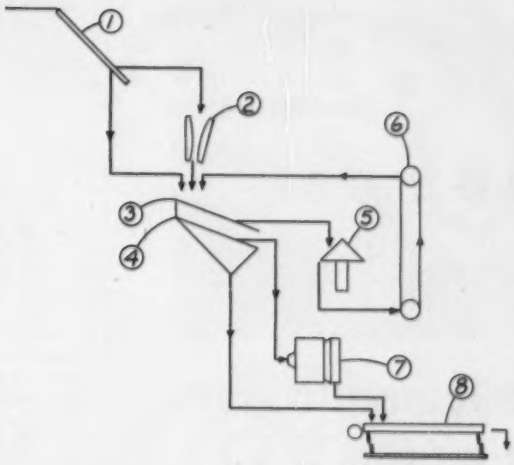
④ Screen

⑤ Kue-Ken gyratory crusher

⑥ Elevator

⑦ Rib-Cone tungsten mill

⑧ Straub Universal tungsten table



In this tungsten plant the finished product is always removed before every crushing or grinding operation to prevent overgrinding and sliming. The Grizzly #1, removes the minus 1″ which goes to the screen #3 which delivers the finished product to the table, #8. Kue-Ken jaw crusher, #2, discharges to the screen where the finished product is also delivered to the table. Kue-Ken gyratory, #5, is in closed circuit with the screen making minus 1/4″ with the finished product continually being removed and sent to the table. The minus 1/4″ with the finished product removed goes to the Rib-Cone "tungsten" mill, #7, which discharges a finished product direct to the table.

This Kue-Ken milling plant is designed for chrome, manganese and gold as well as tungsten and is available in a complete range of sizes.

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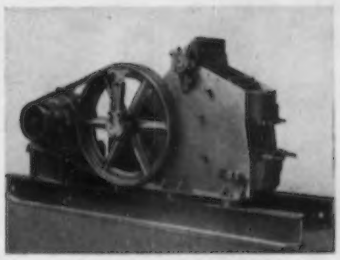
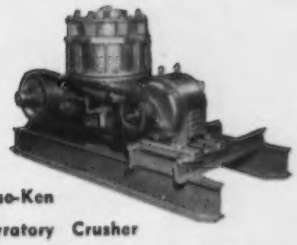
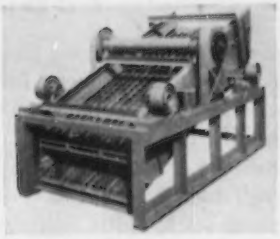


Kue-Ken Jaw Crusher



Kue-Ken Gyratory Crusher

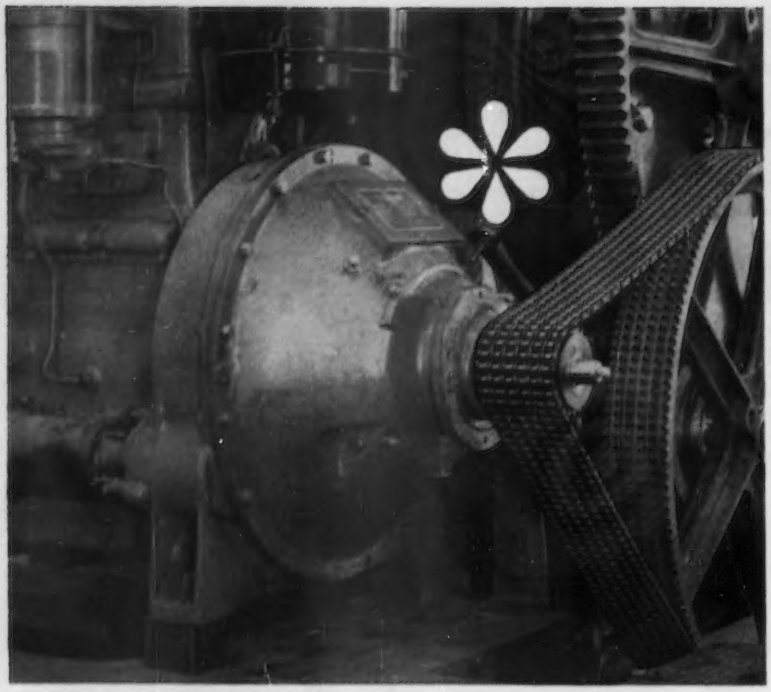
Rib-Cone Mill



Overstrom Screen

Universal Tungsten Table

Sliming and overgrinding are substantially reduced in a Kue-Ken plant. The crushing-without-rubbing principle of Kue-Ken crushers eliminates much of the sliming that occurs when ordinary crushers are used. The principle of screening before every operation and the "zero" pulp line feature of Rib-Cone mill further minimize sliming. Universal Tables with their "curvilinear" deck motion prevent packing and deliver clean concentrates.



Why leading engine manufacturers standardize on this* Power Take-Off

Next time you're watching powered equipment driving through a friction power take-off, check the name plate on the drive back of the engine. In all probability, you'll see a Twin Disc Power Take-Off, putting *more horsepower to work.* With their simple, *rugged* design—single-point adjustment—and slippage capacity far in *excess* of horsepower rating, *Twin Disc Power Take-Offs are selected as standard equipment by most of the nation's leading industrial engine manufacturers.*

That's why you'll find Twin Disc Power Take-Offs on such leading industrial engines as Ajax - Buda - Caterpillar - Climax - Continental - Cummins - Hercules - International - LeRoi - Minneapolis-Moline - Murphy - Superior - Waukesha - White - Wisconsin . . . for these manufacturers know they can depend on Twin Disc performance . . . and they know, too, that wherever their engines may be ultimately working, Twin Disc Service will only be a matter of hours . . . backed by 60 Parts Stations and 8 Factory Branches or Sales Eng. Offices.

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Idaho *(Continued)*

has been found in the silver vein opened last November by North Fork Mining Co. on its Lucky Strike property near Kings Pass on the north side of the Coeur d'Alene District between Wallace and Murray. Sample assays reportedly show sub-commercial values ranging from 0.02 to 0.05% uranium, but Government engineers who have inspected the find are said to consider it well worth further development. The ore is said to be similar to that found at sea-level depth in the Sunshine silver mine on Big Creek between Wallace and Kellogg about three years ago. It is associated with reddish jasparite and pyrite and runs high in silver.

Western Silver-Lead Corp. has acquired a 25% interest in the 9-claim Phoenix property on the northwest flank of the Big Indian Wash in San Juan County, Utah. It is the company's third property interest in the uranium fields and was purchased for $8750. Claims adjoin on the north a property which is reported to be already proven by Homestake Mining Co.

Initial drilling program on the company's original exploration venture—the Juanita group in the Yellow Cat area of Grand County, Utah—has been completed. Sixty-eight holes totaling 7100 ft were drilled, disclosing a zone of low-grade mineralization in the Morrison formation. Cores are now being analyzed by the company geologist who will make recommendations for futher exploration.

Silver Dollar Mining Co. reports that development work during the latter half of 1954 on the 3200-ft level in the New Purim area of the Silver Belt, between the Sunshine and Silver Summit Mines, has exposed a series of short, high-grade ore shoots in both the footwall and hanging wall veins, but no continuous mineable ore zone. Additional work on the 3,000-ft level shows a similar condition of sporadic mineralization. The new 3400 level is expected to reach the mineralized zone sometime in March.

Development is being carried on by Polaris Mining Co. from its lower Silver Summit levels, with Silver Dollar paying a share of the costs. Lincoln Mining and Hayden Hill Consolidated are parties to the development agreement since Silver Dollar leases its holdings in the Purim area from them.

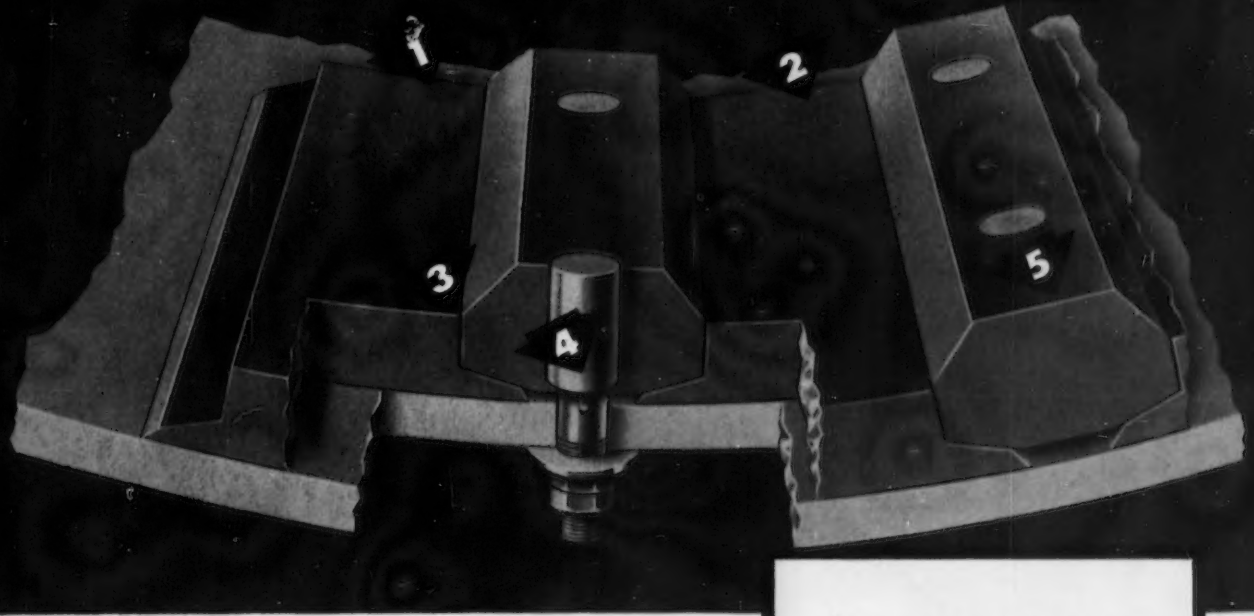
Silver Buckle Mining Co. has started lateral development on the new 750-ft level at the Vindicator Silver-Lead property east of Mullan. A north crosscut is now in progress which is expected to intersect the downward extension of the big Vindicator vein between 250 and 300 ft north of the new shaft. The heading is on a two-shift, six-day basis.

MICHIGAN

During 1954, 699,385 tons of iron ore were shipped from properties managed by Oglebay, Norton & Co. in the Lake Superior District. These shipments came from the Montreal Mine on the Gogebic

USS Lorain Rolled Plate Linings

point to more profitable grinding for you . . .



SERVICE-TESTED USS Lorain Rolled Plate Linings are designed right and made right of the right kind of steel to save you money on each ton you grind. They cut down considerably on mill "down time" because they last much longer than cast linings and they are so easy to replace when it finally becomes necessary.

There are USS Lorain Rolled Plate Linings made to fit any type of mill—for wet or dry grinding. Be prepared for your next replacement . . . send today for names of leading mill manufacturers who can supply you with USS Lorain Rolled Plate Linings.

USS Grinding Balls can help you get better grinding results, too. They are made of special composition steel to take long, rough wear evenly. Samples from each production lot are thoroughly tested. Available in sizes from ¾" to 5".

1. Plates are interchangeable. Heat treating compensates for localized wear. You get complete grinding value from each plate.

2. Plates made to accurate size . . . go in faster, easier.

3. Tight fit between plates and between plates and lift bars eliminates shell wash and allied troubles.

4. Support for bolt head is near bottom of bar . . . bolts are effective for life of the lining.

5. Lift bars designed for correct cascade action. Height of lift varied to suit conditions.

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USS LORAIN ROLLED PLATE LININGS *and* USS GRINDING BALLS

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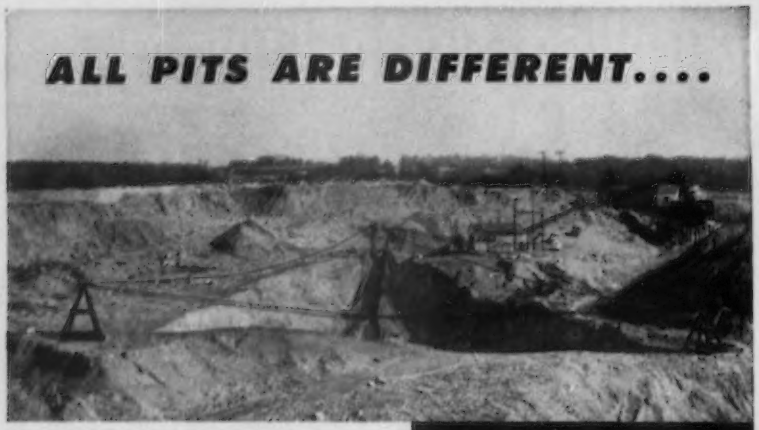
UNITED STATES STEEL



3½-cu. yd. rapid shifter

THAT'S WHY
SAUERMAN SCRAPER MACHINES ARE JOB-ENGINEERED FOR YOUR PLANT

Your deposit may require a manually-shifted tail and bridle system or it may need a rapid shifter to make the many moves necessary in shallow pit operation or handling of non-caving material. If large capacities and long hauls are involved, a Sauerman Track Cable machine may best suit your needs. In the latter arrangement, the scraper bucket is attached by chains to a carrier traveling on a track cable. The bucket conveys its load at ground level and is discharged at the dumping point by merely tightening the track cable. Bucket and carrier guide glide back to the digging point at high speed when brake is released.

5-cu. yd. track cable scraper

Sauerman scrapers work equally well on hills, boggy ground or in deep water. One man controls digging, hauling and dumping from a safe location, which may be as much as 1,000 ft. from the deposit. Sauerman machines cost less than many other types of excavators of similar capacities. Operating costs are very low, because you eliminate the power cost involved in moving heavy machinery around the area. A drag scraper maintains its efficiency for many years. When parts are replaced—sheaves, clutch or brake linings—the machine is restored to practically new condition, even though it may be twenty or more years old.

Write to Sauerman's experienced engineers about your plant

They will give you specific recommendations without obligation. Request *Catalog A, Drag Scrapers*—24 pages of job photos and specifications.

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Michigan (*Continued*)

Range and the St. James mine on the Mesabi.

North Range Mining Co., Negaunee, shipped 465,342 tons of iron ore from four mines, two on the Marquette Range and two on the Menominee Range, during 1954.

Bradley Mine, operated by Edward C. Bradley & Sons, of Iron Mountain, for the Jackson Iron & Steel Co., of Jackson, Ohio, shipped 16,824 tons of iron ore during 1954.

Globe Iron Co., Iron Mountain, shipped 36,420 tons of iron ore during 1954.

Plant construction is well under way at the Republic Mine of Cleveland-Cliffs Iron Co., at Republic, Mich., on the Marquette Iron Range. The plant will contain a primary crushing, fine crushing and flotation section to treat Michigan's iron bearing low grade (jasper) hematite.

The mine and plant are designed for an initial production of 400,000 tons of concentrates per year and are scheduled to go into production in mid-1955.

Ralph S. Archibald, president, North Range Mining Co., announced that its Blueberry Mine on the Marquette Range has been permanently closed because its orebody has been totally depleted.

Some 150 men were affected by the closing of whom some were pensioned and others were placed in the company's other active mines: the Champion at Champion; the Warner at Amasa; the Book at Alpha; the Penokee at Ironwood and the Leonidas at Eveleth, Minn.

Ford Motor Co. operated the Blueberry Mine from 1928 to 1933 during which time it became a "show mine" as to its surface equipment and maintenance.

The Blueberry is the third Michigan Mine to be labeled "exhausted" in the past 2 yr. It was preceded by the Davidson and James Mines at Mineral Hills. North Range Mining Co. took over the operation of the Blueberry from the Ford Motor Co. in 1933—its original mine operation. From 1947 to 1954 inclusive the mine shipped about 1.6-million tons.

MINNESOTA

Sixteenth Annual Mining Symposium of the University of Minnesota Center for Continuation Study was held in Duluth, on Jan. 11 and 12. The symposium followed the annual meeting of the Minnesota Section of the AIME, held Jan. 10.

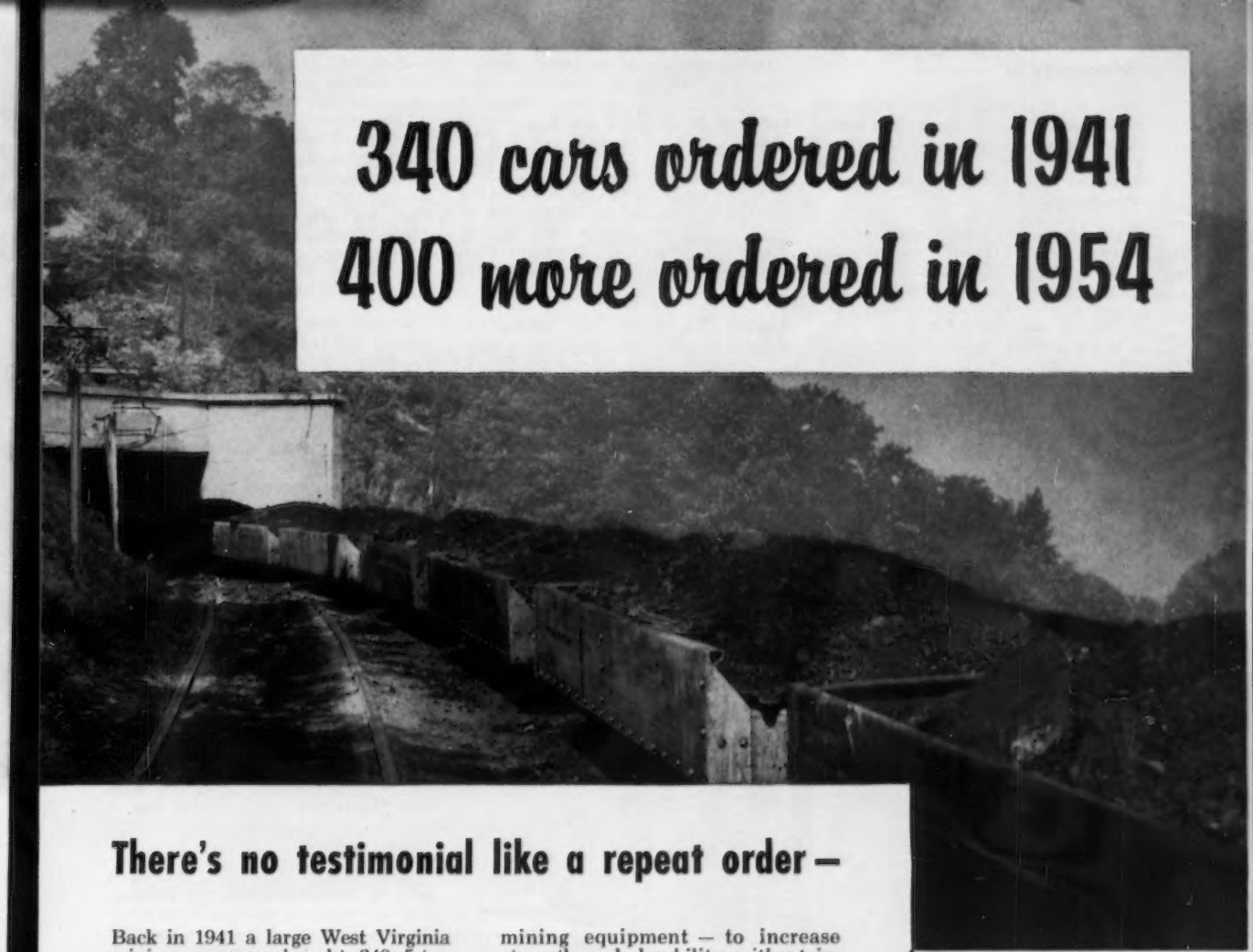
Several papers were presented on soils mechanics and the application of soils mechanics principles to open-pit mining in the Lake Superior district. Other varied papers covered drilling, drill bits in hard ore, use of scrubbers in iron ore beneficiation plants, application of aerial photography to engineering problems, and factors limiting truck size in the Lake Superior district were presented.

During 1954, 1,757,680 gross tons of iron ore were shipped from properties of the

Minnesota (*Continued*)

731,962 tons of iron ore, the largest tonnage ever shipped by them. The com-

ated by the company on the Mesabi. This tonnage was produced from eleven



340 cars ordered in 1941
400 more ordered in 1954

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Back in 1941 a large West Virginia mining company bought 340 5-ton mine cars from A. C. F. Industries, Incorporated. These cars built with USS COR-TEN Steel have been in *continuous operation* for thirteen years, and are still in good operating condition. Because of this excellent service the mining company recently purchased 400 more . . . to be built with USS COR-TEN Steel.

Mining equipment gives extra long service when it is built with USS High Strength Steels—COR-TEN, MAN-TEN and TRI-TEN. That's because these famous steels have a 50% higher yield point, and offer greater resistance to wear, fatigue, abrasion and impact than carbon steel. Mine cars, draglines, 'dozers and buckets made with USS High Strength Steels can work hard and fast to boost production. They stay out of the repair shop, too.

You can use USS High Strength Steels in direct replacement of plain carbon steel in many parts of your mining equipment — to increase strength and durability *without* increasing weight. Or, these tough, strong steels can be used in thinner sections: (1) to reduce equipment weight without reducing its strength; (2) to increase the size and capacity of equipment, without increasing the total weight or the power needed to move it.

And USS High Strength Steels have other special advantages. If your mining equipment must operate in sub-zero temperatures, must handle highly abrasive materials or work in unusually corrosive atmospheres you can build it with the USS High Strength Steel that offers high resistance to these destructive forces. The result—your equipment stays in productive operation and requires less maintenance and repairs.

For more information or application data concerning USS High Strength Steels call or write our nearest office.

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. . . our new "Design Manual for High Strength Steels" contains comprehensive and practical information that you will find extremely useful in designing your products for greater economy and efficiency by the sound use of high strength steels. Watch our future advertisements for the announcement of the availability of this important publication.

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USS HIGH STRENGTH STEELS

USS

S-422

UNITED STATES STEEL

Minnesota *(Continued)*

Jones & Laughlin Steel Corp., Minnesota Ore Division, on the Mesabi Iron Range. This tonnage was produced by five mines: the Hill Annex, the Longyear, the Columbia, the Missabe Mountain, and the Wentworth.

W. S. Moore Co., iron mining and contracting firm of Duluth and Hibbing, shipped 508,915 gross tons from mines on the Mesabi Range during the 1954 shipping season. These shipments came from mines operated by the firm.

In 1953, the W. S. Moore Co. shipped 731,962 tons of iron ore, the largest tonnage ever shipped by them. The company's mining and stripping operations will remain idle until the beginning of the 1955 iron-ore season.

E. W. Coons Co., Hibbing, shipped 205,332 tons from six Mesabi mines during 1954. The company reports that one of these mines, the Lincoln "D", at Virginia, is now depleted. Shipments from the Lincoln "D" in 1954 were 16,559 tons.

During 1954, Pacific Isle Mining Co. shipped 531,124 tons from mines operated by the company on the Mesabi. This tonnage was produced from eleven mines and four lean-ore stockpiles.

Lean material was treated at the company's two plants, both of which contain heavy media, jigs, classifiers, and spirals for concentrating low-grade ore. The 1954 tonnage compares with 551,000 tons produced in 1953, largest production year ever had by the firm. Pacific Isle has had no mines active since late September, with the exception of some stockpile shipments.

Charleson Iron Mining Co., Virginia, shipped 128,113 tons of iron ore from the Charleson concentrator during the 1954 shipping season. This compares with 196,660 tons shipped during the 1953 season.

During 1954, Snyder Mining Co. shipped 594,796 tons from two mines on the Mesabi. Mines operated by the company are the Webb, near Hibbing, and the Whiteside, near Chisholm.

During 1954, Zontelli Brothers Inc., Ironton, shipped 233,802 tons from four mines on the Cuyuna Range and from one mine on the Mesabi.

Pioneer Mining Co., Biwabik, shipped 461,535 tons of iron ore concentrates from its Mary Ellen Mine during the 1954 iron ore shipping season. The firm is now engaged in equipment repairs. Stripping program for the year was completed Nov. 24.

For the sixth successive year Steep Rock Iron Mines, Ltd., shipped more than 1-million tons of iron ore during the 1954 season.

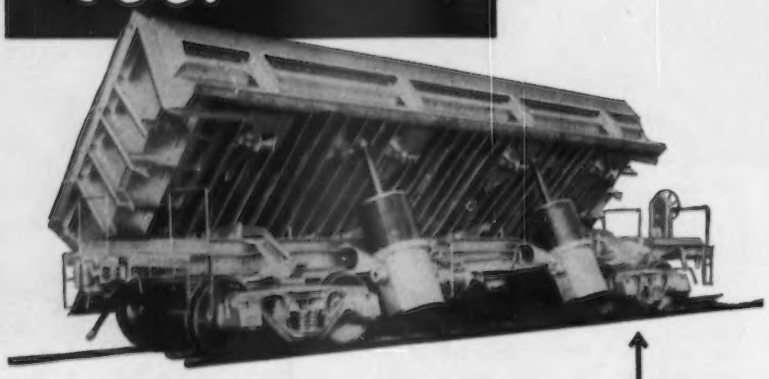
Engineers' Club of Northern Minnesota held its December meeting at Hibbing. Paul R. Leach, Jr., mid-west manager of the extension division of the Du Pont Co., spoke on the subject, "An American Paradox". He discussed some of the new developments in chemical research and the chemical industry.

After its ore season ended Nov. 23, Enterprise Mine of M. A. Hanna Co. carried on stripping on a 15 shift per week basis. At the company's Weggum Mine, the screening plant has been moved to a new location.

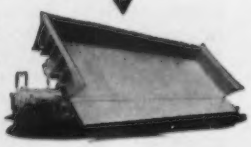
A new Aerofall crushing unit, which eliminates some crushing stages formerly done by other equipment, was begun at Jones & Laughlin Steel Corp.'s Star Lake, N. Y., operation in August 1953, and completed in October 1954. The new mill is expected to increase output of the concentration plant by 300,000 tons per year. The 1954 production was about 1.3-million tons.

E. A. Young of Hibbing and associates have taken up 59 claims, known as the Running Wolf, in the Little Belt Mountain area near Great Falls, Mont. Four diamond drill holes have been put down and results have been very satisfactory—some of the samples showing a 60% natural in iron. Joe Levallo of Young's Hibbing organization was in charge of the exploration and drilling. Further exploration will be conducted.

BOOSTS EARNINGS TOO!



DUMPS BOTH WAYS



The Differential Air Dump Car has a way with operating expenses — cuts 'em down!

There's another pair of massive muscles on the other side of the car, too, means two-way dumping and greater flexibility.

They're built to take rough treatment — whether it's the slam-banging of the clam or the sudden dumping of tons of hot slag. These cars can take it and can come back faster for more.

Higher ratio of payload to dead weight! Fewer trips to the shop and shorter stays when they do go! Add all these up and it spells lower operating costs — another way to say "Boosted Earnings". Write for the full story on these cars.

Other Differential Products: Locomotives, Mine Cars, Mine Supply Cars, Rock Larries, Mantrip Cars, Dumping Devices and Complete Haulage Systems.

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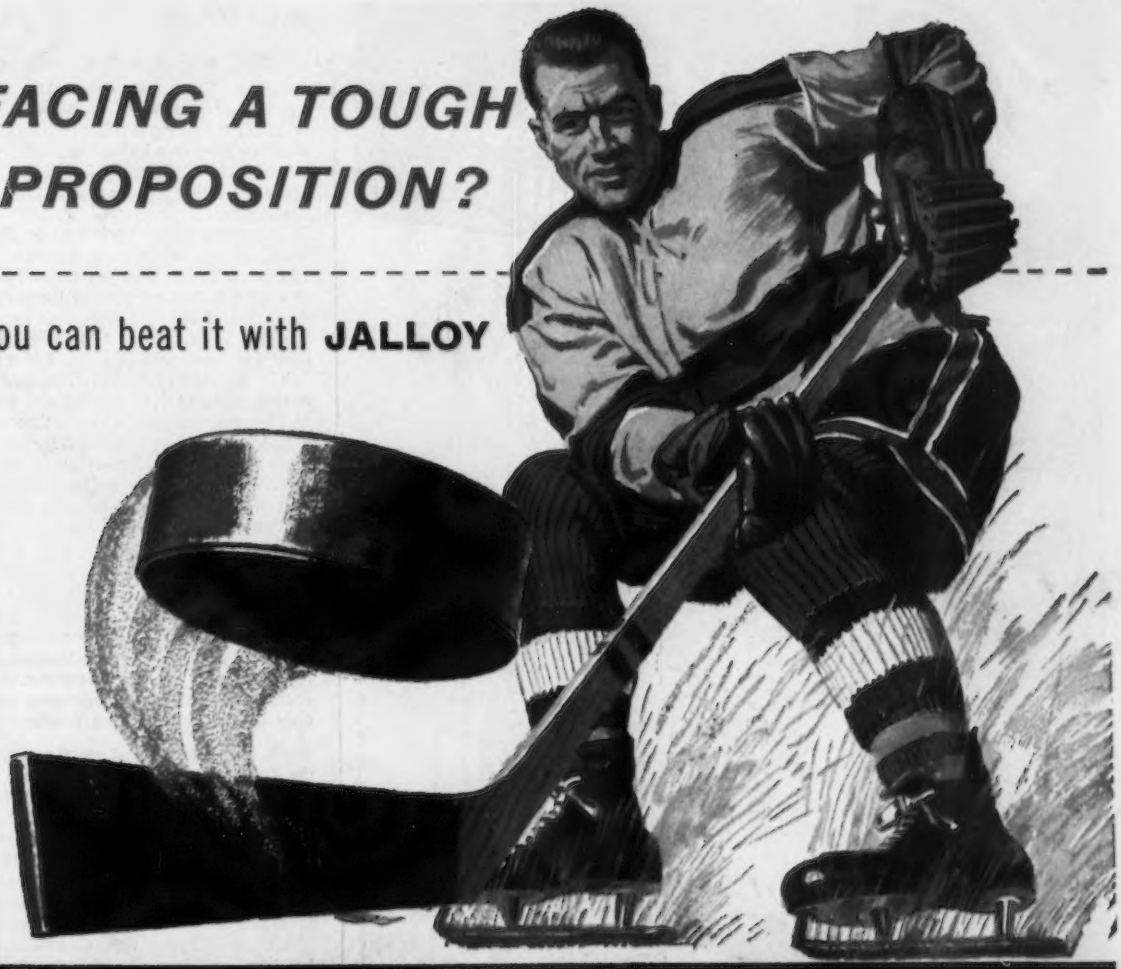
you can beat it with **JALLOY**



J&L JALLOY HEAT-TREATED PLATE BEATS WEAR DUE TO ABRASION

J&L Jalloy Heat-Treated Plate is the special purpose steel that is heat treated to provide longer wear on applications where impact and abrasive conditions are severe.

In comparison with other abrasion-resistant steels as well as mild steels, it gives optimum results when heat treated to a Brinell hardness of 340 and up. Jalloy permits savings in steel costs, maintenance, and repair. Furthermore, it is easily welded. Jalloy is available in three grades to meet various service requirements.

J&L STEEL

Jones & Laughlin
STEEL CORPORATION — *Pittsburgh*

Complete data concerning CHEMICAL COMPOSITION . . . HEAT TREATMENT . . . WELDABILITY . . . PHYSICAL PROPERTIES . . . will be mailed to you promptly. Write today.

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3 good reasons why you can depend on JKS Diamond Drill Bits

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FOUNDATION TESTING
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- Proven designs in three distinct powdered metal matrices for various drilling conditions.
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Other Plants in
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MONTANA

Minerals Engineering Co., of Grand Junction, Colo., has purchased all the stock and assets of American Alloy Metals Inc., giving it full ownership of the Ivanhoe (Brown's Lake) tungsten mine in Beaverhead County, which it has been operating under a lease and profit-sharing agreement.

Expansion of the concentrator plant at Glen, Mont., to increase capacity from 12,000 to 20,000 tons per month, is now in progress. Ore reserves at the mine are estimated at 829,000 tons. The ore body is about 60 ft thick and has been proven over a strike length of about 1,000 ft.

The Ivanhoe Mine was developed from a raw prospect into one of the nation's leading tungsten producers in three years. Two loans totaling $98,804 were obtained from the DMEA, but most of this has been repaid out of royalties on production and it is expected that the debt will be liquidated early in 1955.

NEVADA

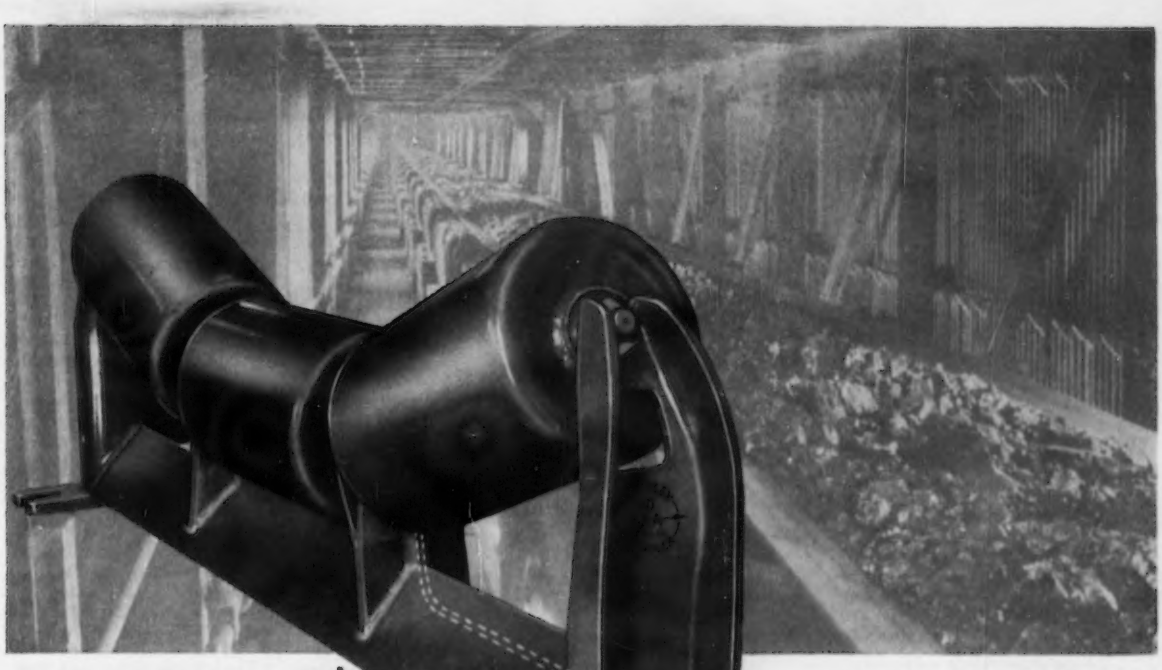
Wage increase of 6c per hour was granted workers at the Nevada-Massachusetts tungsten mine during December. Negotiations with the company were carried only by the United Mine Workers local.

Work has been started on the repair of the 150-hp counterbalanced electric hoist of the Laguna shaft of the Goldfield Consolidated Mines Co. at Goldfield. All skids will be replaced down to the 450-ft level and later to the 600-ft level. Harold V. Lankford, in charge of the operation, says the Laguna shaft will be used to penetrate the Columbia Mountain fault which cut off the rich Goldfield vein. Existing workings on the 450-ft level will be opened up and re-timbered, leaving only 100 ft to go to enter Columbia Mountain. It is planned to contact a 1500-ft drift with cross-cuts to connect all the existing ore bodies now exposed.

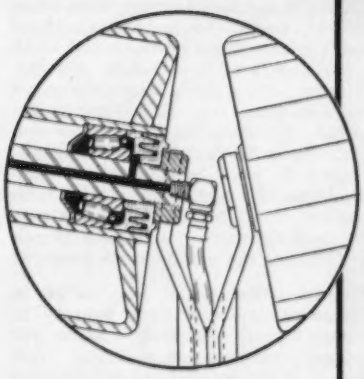
Tungsten ore from the Minerva Mine in southern White Pine County is being hauled to Ely at the rate of 50 tpd for treatment at the old Baltimore Camas mill. Combined Metals Reduction Co., operator of the property, was formerly shipping the ore to Bauer, Utah, but switched when the Minerals Engineering Co. of Salt Lake City took over the Baltimore Camas mill and contracted to process the output. Development work at the mine is proceeding under James G. Hulse.

Uranium ore is now being shipped from the Rundberg Mine in Lander County which is being operated by Uranium Mines Inc. Workmen have drifted over 50 ft in a tunnel and have found good ore all the way for a width of 20 ft, according to reports. Fred Vollmer, of Austin, is in charge of the operations.

Southern Nevada subsection of the AIME was reactivated during December. Sidney McCarroll is chairman, James Orr is vice chairman, and Ray Lundquist is secretary of the new organization.



A typical S-A Conveying System that depends on S-A Carriers for long, low maintenance service.



Roller is spun from a single piece of heavy gauge tubing with inner bearing tube welded to spun-ends. "One-shot" lubricates bearings at both ends of rollers.

"SIMPLEX" Carriers . . .
the "Foundation" for Belt Conveyors that Means Lower Operating Costs

By providing a low friction, low maintenance "foundation" for belt conveyors, "SIMPLEX" Carriers are helping to cut power and servicing requirements on hundreds of conveyor installations. Unique cost-cutting "SIMPLEX" features include:

SPUN-END, ONE-PIECE ROLLERS — Recessed ends permit close roller spacing for maximum belt support and longer belt life.

BELT TRAINING DESIGNS — Automatically trains belt without edge rollers. Excessive edge wear caused by these rollers is eliminated.

FAST, SAFE LUBRICATION — Flexible tube to center roller permits lubricating without reaching under moving belt. Both bearings are greased with one "shot". Outside rollers may be greased direct or through tube from most convenient side of carrier.

LABYRINTH GREASE SEALS—Retain lubricant, keep out dirt and moisture, promote longer bearing life.

INTERCHANGEABLE PARTS—Permit fast easy replacement, reduce stocks.

ALL-STEEL CONSTRUCTION—One piece frame accurately jig-welded for strength with minimum weight.

"SIMPLEX" Series 220 Carriers are available with five or six inch diameter rollers for any belt conveyor 18 to 60-in wide. They are one of a complete line of carriers manufactured by Stephens-Adamson — for over 50 years leaders in the design and construction of complete conveying systems. Full "SIMPLEX" data in Bulletin No. 453. Write for a free copy.

Ask S-A to Engineer Your Conveying System

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Will

Your Rig

drill a portion of the estimated four million feet of uranium exploration in 1955?

The Atomic Energy Commission's program of undertaking a large portion of exploration core drilling in the past has borne fruit. Exploration activity by private companies had increased to a point in 1954 where over three million feet were drilled and estimates for 1955 are placed at over four million feet of exploratory drilling. But, with this increased activity operators are demanding improved techniques and equipment, faster drilling, lower costs, deeper holes and larger cores with higher percentage of recovery.

Because of the variety of rigs now in use for uranium exploration, Christensen Diamond Products Company has prepared a brochure on recommended associated equipment, to be used in conjunction with these various type drills. This brochure is offered free upon request and lists such items as recommended pump, recommended core barrel, drill rod, OD tool joints, etc.

A well planned exploratory drilling program means greater profits for you so why not avail yourself of Christensen Diamond Products Company's vast experience to help you select the right bit and core barrel combination for your uranium drilling?

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Gentlemen:
Please send me your free booklet on drilling in the uranium regions.

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Nevada *(Continued)*

New pilot plant built by Manganese Inc., of Henderson, is in operation and working smoothly under supervision of Francois A. Fischer, chief metallurgist. Jim McIntosh, engineer, and Dick Bordwell, technician, are in charge of designing the mill circuit to reproduce the conditions in the pilot plant which will continue to be used to conduct test runs at a fraction of the cost that would be involved in the mill proper.

Grand Mining Co. which operates at Spring Valley in Lincoln county, recently shipped 202 tons of gold, silver and lead ore to the smelter and got satisfactory results. The shipment contained 13.2 oz of gold, 719 oz of silver, and 131,695 lb of lead. Officials of the company are preparing a long range development program to facilitate removal of ore from the 800-ft level and are also drifting on the 600-ft level to provide an air connection and explore for ore. Paul C. Lyon Jr. is secretary of the company, which has offices in Salt Lake City.

Consolidated Uranium Mines, Inc., has completed a large bunk house and new kitchen at its Linka Tungsten mine, 20 mi east of Austin. Ore is being stockpiled awaiting completion of a new mill which when completed will handle 200 tpd. Reports indicate that a large body of ore has been found near the 300-ft level and already the shaft has been driven into the deposit. Surface drilling has supplemented the work. Several hundred thousand tons of scheelite ore, ranging from one-half of 1% to some high grade rock has been encountered. At present 25 men are working three shifts at the property.

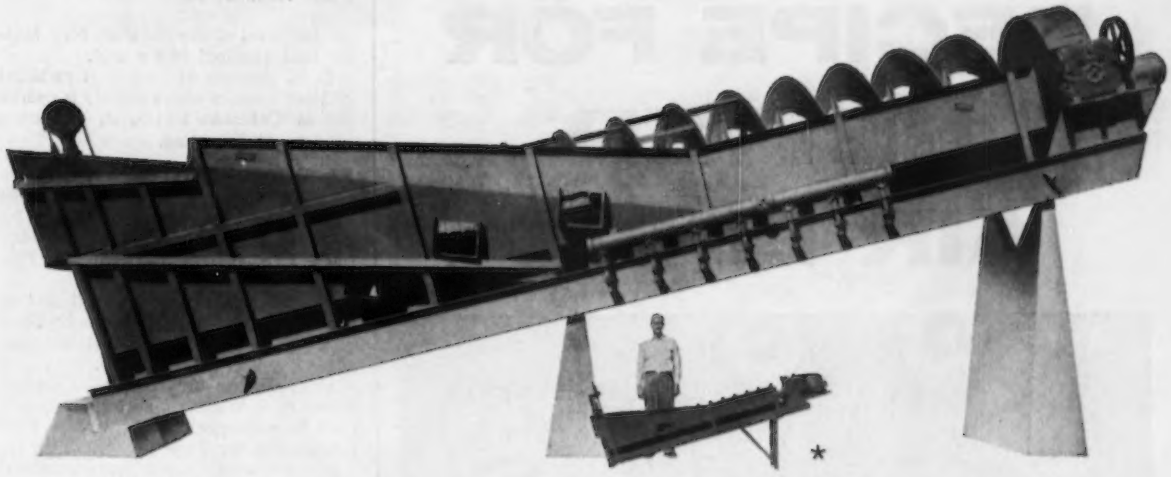
Eldorado Mining Co. has moved in equipment at its uranium property in Veetch Canyon 3 mi south of Austin and drilling operations are underway. Norman C. Williams, of the Geoprofessional Service, Inc., of Salt Lake City, reports that uranium mineralization was found in the fissure of the area and that a considerable increase is shown in the count at 1 to 2 ft below the surface. Extensive test operations are being made.

Mohawk Mill near Silver Peak is being revamped and enlarged and Avery Brundage, of Chicago, owner of the Mohawk property, plans to reactivate the mine operations on a major scale. The mine is a potentially important silver producer. Church Holmes, metallurgist formerly with Sunshine Mining Co. is in Tonopah to direct the project, and E. R. Hines is in charge of the operations locally.

NEW MEXICO

Four Corners Uranium Corp. of Denver, Colo., has acquired the properties of the Largo Uranium Corp., and General Uranium Corp., both of New Mexico, in an exchange-of-stock transaction involving more than $1-million at par value.

The Colorado firm announced it would begin drilling before the end of January



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TWO 84" DIAMETER WEMCO S-H CLASSIFIERS

Illustration shows one of the two large classifiers recently completed by Wemco for installation in the iron-ore beneficiation circuit of a major producer on the Mesabi Range. These units will serve to wash and deslime fines in a plant having an overall capacity of 700 LTPH. They also will operate to prepare feed for a cyclone treatment plant.

Whatever your classifier problem— WEMCO offers a model to fit your job

Whether you have a small, medium or large tonnage circuit, the exclusive design of Wemco S-H Classifiers offers flexibility to suit your particular operations. In addition to a wide range of sizes, Wemco Classifiers offer many design variations: simplex or duplex — straight, modified or full flare tanks — single, double or triple spirals — high, standard or submerged weirs — and short, medium or long lengths.

Modern Design Gives Wemco Classifiers these METALLURGICAL ADVANTAGES

Greater overflow capacity — up to 25% more effective pool area.

Sharper separation — due to controlled agitation and larger effective pool area.

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Balanced operation — between overflow and raking requirements.

★ Photo shows size comparison between 84" and 12" Wemco S-H Classifiers.

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LIGHTWEIGHT — without sacrifice of strength, assures easy handling and installation.

SAFETY — through the spiralweld lockseam which acts as a continuous expansion joint to absorb shock loads, stresses and strains.

GREATER COLLAPSE STRENGTH — through the reinforcing spiral truss which permits lines to be operated under vacuum as well as pressure.

For the complete story on this outstanding light weight pipe, write for Bulletin No. 507.

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New Mexico *(Continued)*

on 480 acres of northwestern New Mexico land acquired in the deal.

E. H. Sanders of Denver is president of Four Corners which already is operating in Colorado and Utah and owns property in Wyoming.

Freeport Sulphur Co., which plans a $16-million potash mine and refinery in the Carlsbad, N. M., area, has asked the New Mexico land commissioner to work out a 360-acre land swap with the Federal Government.

The tract is Federally-owned and as such not available for purchase by Freeport. If it were state-owned Freeport could buy it at public auction.

Freeport has asked Land Commissioner E. S. Walker to seek the 360-acre tract in exchange for some other state lands which the Federal Government recently condemned for military purposes. Walker said he has relayed the request to the Bureau of Land Management.

The land commissioner reported that Freeport has spent $200,000 in core drilling in Lea County (south-eastern New Mexico) during the last two years.

Western Development Co.—an oil and gas producing firm headquartered in Santa Fe, has announced plans to re-open the long-abandoned Cerrillos mining district 20 mi southeast of Santa Fe and to build a mill to process lead and zinc ore there.

William E. Scorah, president of the company, said a target date of early summer had been set for reopening the non-ferrous mines.

Scorah said indications have been found that commercial quantities of uranium and other minerals may be found in the area and his company has taken exclusive mining and prospecting rights on 17,000 acres south of the lead-zinc mining area.

Potash production—biggest mining industry in New Mexico—set a new record during 1954, according to a report compiled by the various companies operating in the Carlsbad area of southeastern New Mexico.

Production from the five Carlsbad area plants totaled nearly 2-million tons during the year. And for the first time in history deliveries of potash in North America passed the 2-million ton mark.

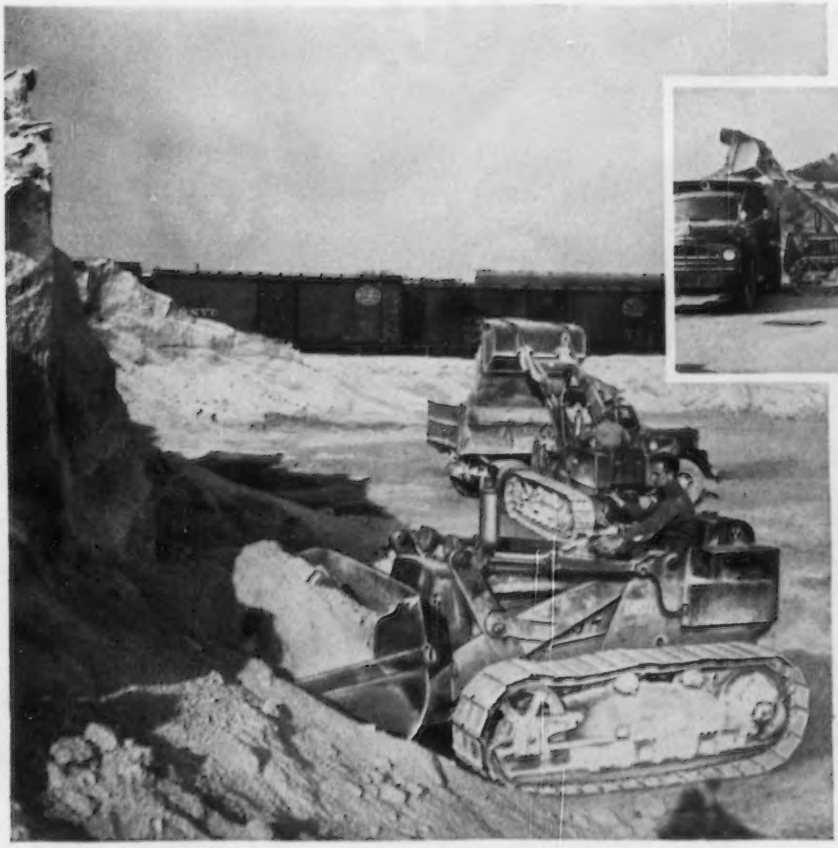
But warnings were sounded by John A. Garcia, of Albuquerque, state mine inspector:

"Although production has increased each year, it is my opinion that production has reached its peak.

"My opinion is based on the fact that German potash has appeared on our markets and according to all reports, the German potash is shipped in to the Atlantic sea coast cheaper than it can be mined and shipped from the Carlsbad area.

"The known potash resources in the Permian Basin (southeastern New Mexico) . . . are sufficient to supply the markets for 200 yr," Garcia said. "With this much potash in reserve, it is the consensus that not a ton of foreign potash

Low Cost Way to Load 185 Tons an Hour



MORE OF THE SAME: *"In 9 months our first TD-9 and Skid-Shovel loaded out over 140,000 tons of road screenings plus farming 300 acres,"* relates N. S. Purtee, partner in the Genoa Construction Company. *"This outstanding and continuous performance clinched the sale of a second loader eight months later."*

LOADING LIMESTONE SCREENINGS is a low-cost materials handling operation for these TD-9s with Skid-Shovels as each unit averages 185 tons an hour, and the two loaded out 40,652 tons one month when one machine only worked two weeks of that period.

Ohioan's invitation to salesmen to "show me something better" than his INTERNATIONAL DROTT TD-9 Skid-Shovels is not accepted.

N. S. Purtee, partner in the Genoa Construction Company of Genoa, Ohio, wants the best front-end loaders available to load out road screenings for a new super highway, so he always tells equipment salesmen: *"Fellow, watch my* INTERNATIONAL DROTT *TD-9 Skid-Shovels work and if you have something better, bring it out."*

His standing invitation has not been accepted for several reasons: INTERNATIONAL DROTT Skid-Shovels—all four sizes—have exclusive Skid-Shoes that utilize the ancient lever principle to develop 300% greater pry-out force than competitive loaders.

This means bigger loads with materials of any density and these heaped loads are retained by a 41° bucket roll-back at ground level feature. Loading force is transferred into the ground by the Skid-Shoes which also enable loads to be semi-skidded at ground level in third rather than first gear.

The Hydro-Spring, a mechanism that absorbs 70% of loader shocks, not only extends equipment life but makes operation of the machine far easier on the operator.

For a short cut to lower cost material handling, call your INTERNATIONAL Industrial Power Distributor. See the highest producing loaders on the market today in action on your job.

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for copper converter linings . . .

These carefully controlled refractories are made from the best quality raw materials, are formed under high pressure and are fired extremely hard. Dependable workmanship and uniformity are assured.

In addition, Harbison-Walker produces various other classes of basic refractories for every metallurgical furnace need.

HARBISON-WALKER

provides Two service-proved basic refractories

• Chromex B

Briefly summarized, the desirable properties which account for the excellent service secured with this extra hard fired chrome-magnesite refractory are:—high density and impermeability—relatively low thermal expansion and good resistance to thermal shock—unusual stability and high strength at high temperatures.

• H-W Magnesite

For the most strongly basic linings this refractory, consisting predominantly of periclase (stabilized crystalline magnesia), fulfills the most severe requirements. It is fired at an extremely high temperature and is dense, strong and volume stable at temperatures far above the highest employed in copper converters.

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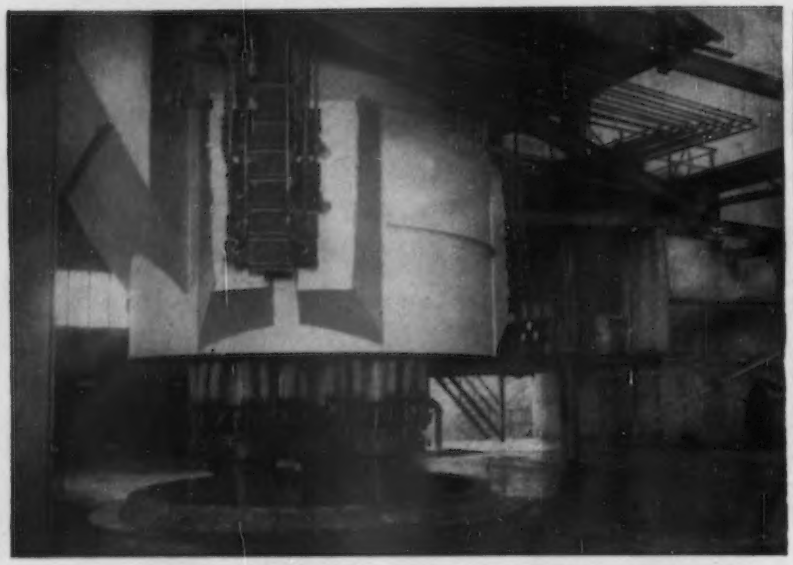

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The Soderberg Electrode System
Metallurgical plant design and erection

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NAGLE PUMPS are used at Jones & Laughlin Steel Corp.'s Aliquippa Works, Otis Works, Vesta Shannopin Coal Preparation Plant, on the Mesabi range and at Benson Mines, Star Lake, N. Y. . . . doing a variety of pumping jobs . . . every one an abrasive, gritty pumping job . . . just the kind of pumping jobs Nagles take to.

Nagle Vertical Cantilever Pumps eliminate stuffing box troubles, pumped materials do not come in contact with bearings, water end parts made of material most suitable for the particular application. Horizontal and vertical shaft types for every abusive service. No wonder Nagles have become so widely used in less than 10 years.

Get the facts—Send for Catalog 5206 and names of mining company users!

6" type "SW-OB" pump in pit drainage service, fifth cut, J & L Benson Mine, Star Lake, N. Y. . . . one of 10 Nagle Pumps at this operation.

NAGLE PUMPS

NAGLE PUMPS, INC.
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PUMPS FOR ABRASIVE AND CORROSIVE APPLICATIONS

New Mexico *(Continued)*

should be permitted to enter this country."

NORTH CAROLINA

Lithium Corporation of America has just put a new $7-million plant into operation at Bessemer City.

The plant is processing spodumene ore from two mines in the Bessemer City and Kings Mountain area which is transported to the plant by truck for chemical processing. The mines have been running since last summer and over 100,000 tons of raw ore have been stockpiled for processing.

Although only two mines now are operating, the company owns 22 other mining properties in the area which will be developed as needed.

The new plant has approximately 200 employees, including those engaged in mining operations. Lithium is being shipped directly to Lithium Corporation's main plant at Minneapolis. Gerald A. Munson has been appointed acting general manager of the plant. R. L. Nielson is plant manager.

OREGON

Mining Laws of the State of Oregon, designated by the state department of Geology and Mineral Industries as Bulletin No. 1, has been reissued in a fourth revised edition in conformance with numbering and wording of Oregon Revised Statutes which the 1952 legislature adopted. Staff geologist Ralph S. Mason assembled the new bulletin material from ORS pages supplied by the State Statute Revision Council.

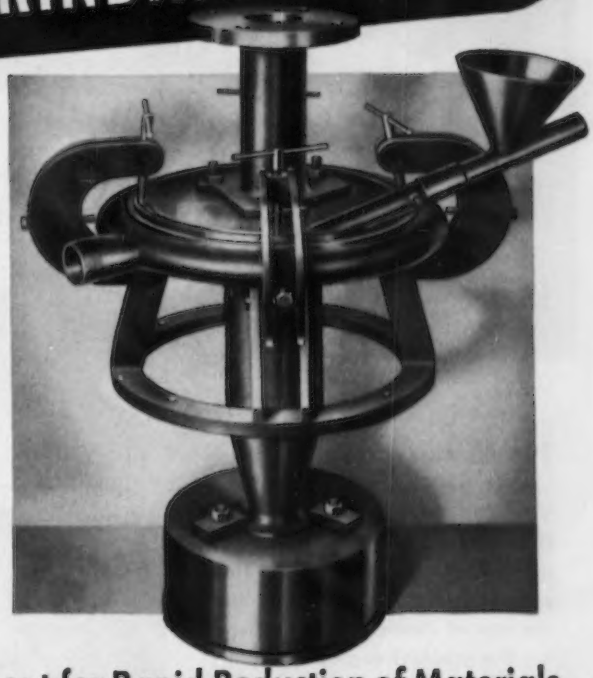
Production of limestone at the National Industrial Products Corp. quarry at Durkee in Baker County is averaging about 15 railroad cars per working day, an estimated 825 tons. Output is going principally to sugar and paper mills.

Canyon Creek Mining Co., Princeville, has leased the Herschoff furnace on the Ochoco Mining Company's property in Crook county to test ore from the Mother Lode quicksilver mine some 30 mi south of Princeville. The property has been developed the past season by Frank Reid and associates.

Chromite shipments to the GSA defense minerals depot at Grants Pass have stepped up with closing of mining season along the Oregon-California border counties and the depot has confirmed that Nov. 8 was the second heaviest receipt day since Nov. 23, 1951, the opening, when shipments accumulated for the program were rushed to the depot. Specific late 1954 tonnage has not been announced, but GSA reports 70,070 tons of chromite ore and concentrates have been checked into the depot under the program which expires June 1955. Bulk of the shipments has come from six counties of

Sturtevant

MICRONIZER* GRINDING MACHINE



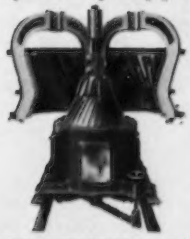
Reduces Solids to Micron Sizes

The new Sturtevant *Micronizer* grinding machine is a fluid jet grinder especially designed to reduce solid materials to particle sizes in the micron ranges.

Sturtevant *Micronizers* are used for simultaneous dry grinding and classification of solids. The variety of materials that can be processed is large and includes both metallic and non-metallic minerals and ores, metals, pigments, insecticides, fungicides, pharmaceuticals, plastics, dyes and numerous other organic and inorganic products. Available in capacities from ½ to 3000 pounds per hour.

Other Sturtevant Pulverizing Equipment for Rapid Reduction of Materials...

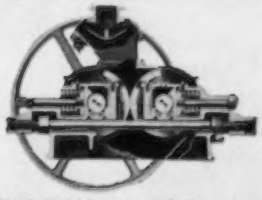
Especially Applicable for Initial Grinding of Products for the Micronizer Mill



ROTARY FINE CRUSHERS for intermediate and fine reduction (down to ¼"). Open door accessibility. Soft or moderately hard materials. Efficient granulators. Excellent preliminary Crushers preceding Pulverizers.

JAW CRUSHERS for coarse, intermediate and fine reduction of hard or soft substances. Heavy or light duty. Cam and Roller action. Special crushers for Ferro-alloys. Several types, many sizes.

RING-ROLL MILLS for medium and fine reduction (10 to 200 mesh), hard or soft materials. Very durable, small power. Operated in closed circuit with Screen or Air Separator. Open door accessibility. Many sizes. No scrapers, plows, pushers, or shields.



CRUSHING ROLLS for granulation, coarse or fine, hard or soft materials. Automatic adjustments. Crushing shocks balanced. For dry or wet reduction. Sizes 8 x 5 to 38 x 20. The standard for abrasives.

SWING-SLEDGE MILLS for coarse and medium reduction (down to 20 mesh). Open door accessibility. Soft, moderately hard, tough or fibrous substances. Built in several types and many sizes.

AIR SEPARATOR for separation of fines to 325 mesh and finer. Increases output from 25% to 500%... lowers power costs by 50%. Capacities ¼ to 50 tons per hour output.

*Registered trademark of the Sturtevant Mill Company

STURTEVANT MILL COMPANY

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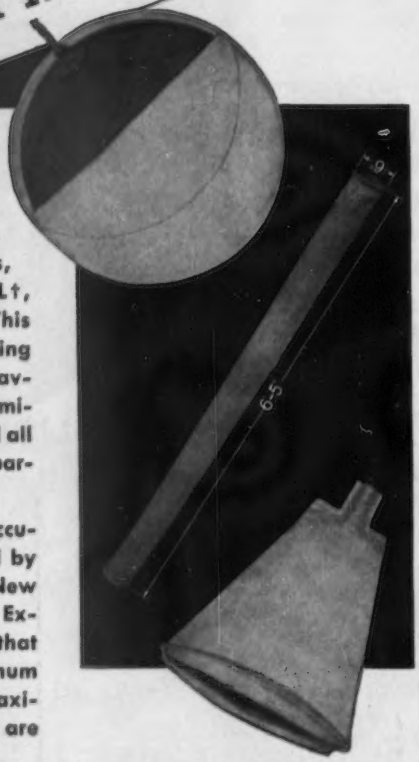
- Vacuum and Pressure Filter Element Covers
- Dust Collector Tubes, Bags and Envelopes
- Anode Bags

Let US make up your Element Coverings from NFM Filter Media



NFM Filter Media are woven from Nylon, ORLON*, VINYON N**, Saran, Glass, Dynel, Cotton, VINCEL†, DACRON††, and TEFLON***. This wide range insures your obtaining the type of element covering having the greatest degree of chemical resistance and best general all round performance for your particular operation.

NFM element coverings are accurately and durably fabricated by skilled personnel at both our New Haven and Salt Lake plants. Experience has demonstrated that filter cloth costs are at a minimum and filter performance at a maximum wherever NFM products are employed.

If you are not absolutely certain as to which type of synthetic or natural fiber is best for your use, send us a complete description of your operating conditions and we'll be glad to make a recommendation. Our many years of experience mean that we have quite a fund of knowledge at your disposal.

* TM for Du Pont acrylic fiber
** TM—Union Carbide & Chemical Co.
*** TM for Du Pont Tetrafluorethylene Fiber
† TM—NFM Reg. U.S. Pat. Off.
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Oregon (*Continued*)

southwest Oregon and from mines in California and Alaska.

Staff geologists and engineers of the Oregon State Department of Geology and Mineral Industries have collaborated on an extensive general article entitled "Uranium Prospecting" for the current issue of "Ore. Bin." The preface states it seeks to answer questions asked the department about minerals, radiation detection equipment and the laws governing locations of claims for fissionable materials and lists references to published information on uranium minerals and prospecting for them.

Location of a group of claims for chromite ore in a new sector of southern Oregon and confirmation that the concentrates are running 51% to 55.57% chromic oxide, far higher than average ore delivered at the GSA receiving depot in Grants Pass, climaxed the 1954 developments in this active Oregon-California mining field.

Oregon Department of Geology and Mineral Industries reports the location on Red Mountain, about 12 mi southwest of Ashland, in Jackson County, and farther east than any previous chromite ore locations. The area is designated on the State Geologic Map as Sec. 29, T403, R1W.

Department Acting Director Hollis Dole reported the GSA's depot had confirmed receipt from the properties of 18 tons of ore which proved 51% chromic oxide and a latter shipment, quantity unannounced, which was 55.57%. This latter figure works out at $165.28 per ton, according to the department's field office at Grants Pass.

The property had been located by Everett and Ernie McTimmonds, both of Grants Pass, but Everett subsequently sold his interest to James Stinebaugh, also of Grants Pass. The property was closed down in late October by winter weather. Chromite is massive in formation at the property.

A bulldozer is being used by Wesley Pieren and Antone J. Nielsen of the Evergreen Mining Co. for stripping overburden from six placer gold claims on Galice and North Fork creeks in Josephine County. Operations were scheduled to start in late December when streamflow rises.

UTAH

One of the first suits in history over conflict of oil and gas interests with those of miners is on file now in U. S. Federal District Court in Salt Lake City.

The suit was filed by the Kanab Uranium Corp., Betty G. Morgan and Audrey H. Peterson against Consolidated Uranium Mines Co. Property in question covers 3,040 acres in Emery County.

Plaintiffs say they are holders of oil and gas leases on the land and that Consolidated Uranium Corp. has prohibited the plaintiff's drillers from entering the public domain.

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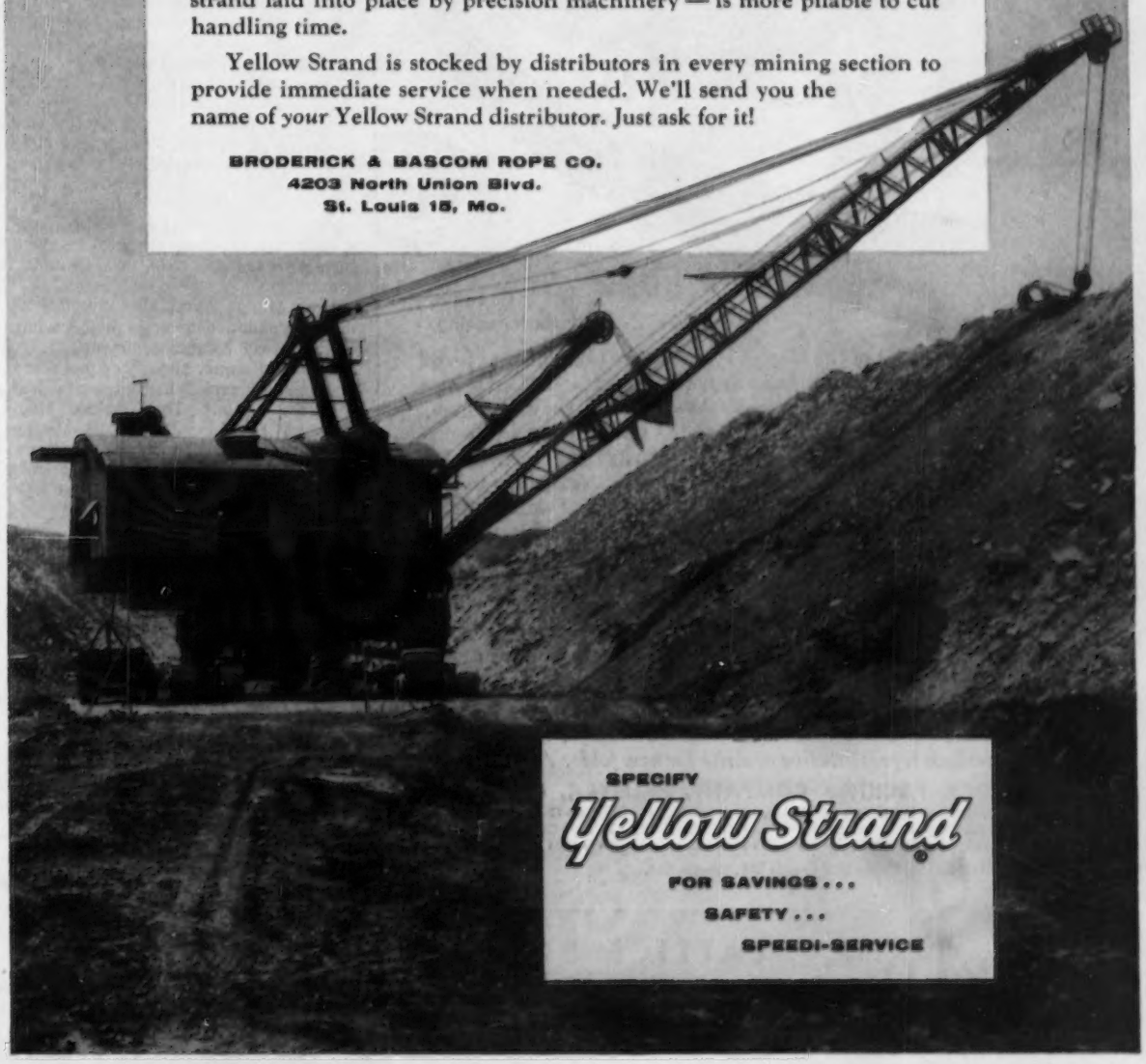

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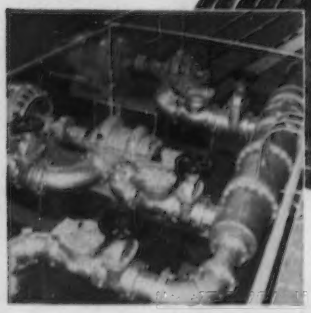
Centrifugal pumps at Parkersburg, W. Va., Water Dept.



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Utah (*Continued*)

Court is asked to determine rights of the defendant to the lands and to award the plaintiffs $5,000 for damages allegedly resulting from interruption of an oil and gas drilling contract.

Utah Mining Assn. is launching a new public relations drive to acquaint AEC with effects of its domestic uranium purchasing program on economy of the West.

The group resolved at its annual meeting in mid-December that so long as purchase of uranium ore remains a Government monopoly, the AEC must give assurances of continuing the buying program past the 1962 cut-off date.

According to the resolution, the mining group "considers the March 31, 1962, limitation of the minimum purchase price program to have a seriously repressive effect upon the long range aspects of uranium production."

It says that "Investments in prospecting, exploration, mine development, milling plants, as well as in badly needed housing and community services for employees in the communities where uranium production is situated, all have to be made on a free enterprise principle of investment for profit.

"In contrast, the purchase and use of fissionable materials, the marketing and processing end of the business, is strictly a Government monopoly. Companies having the know-how and the staff to operate such mills are loath to commit such personnel, with the necessary supporting organizations, to projects with such short life assurance," the resolution continues.

Utah Mining Assn., also says that as the termination date nears high-grading of mines will become commonplace.

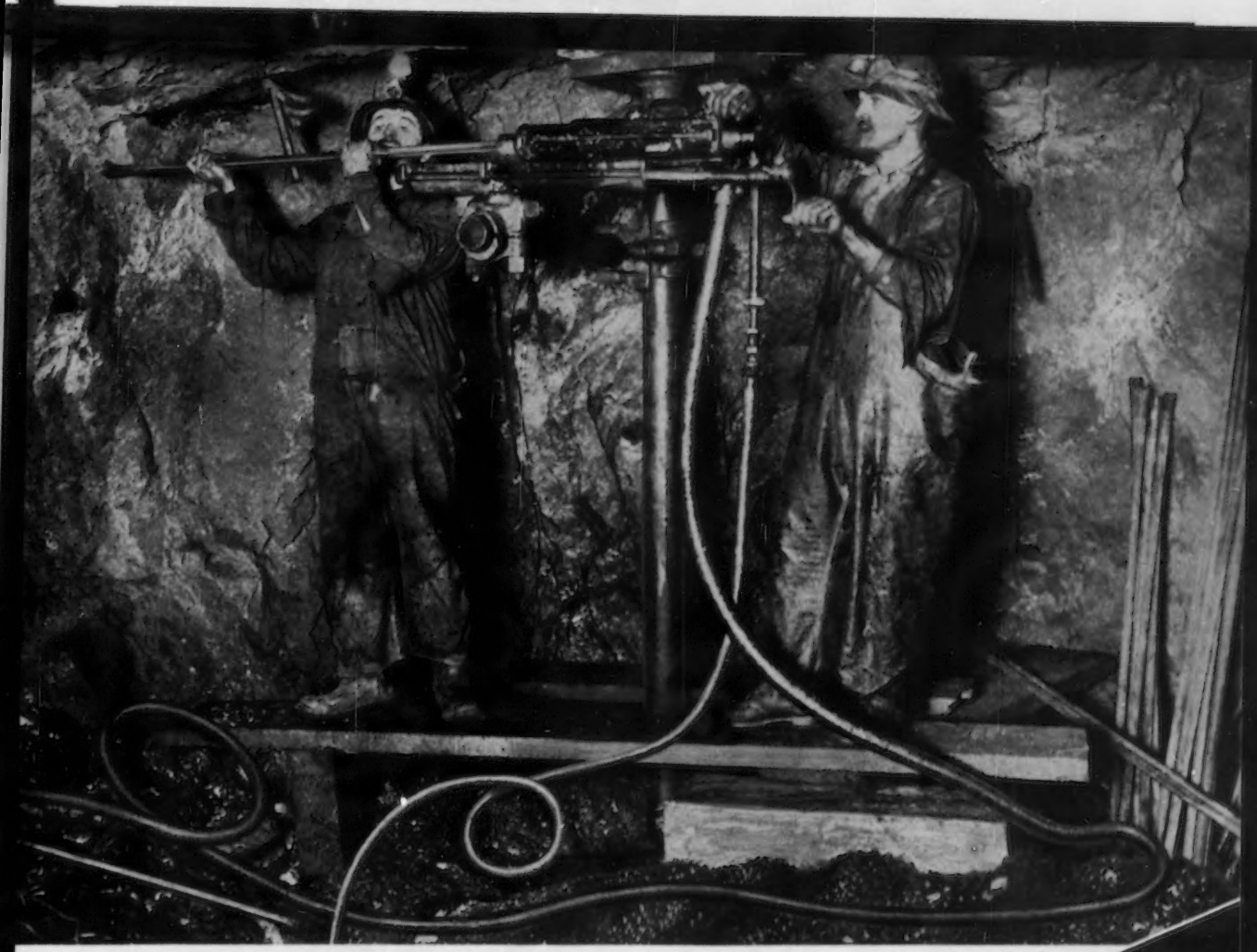
Miles P. Romney announced that seven uranium companies had now affiliated with the group. They include Utah Uranium Division, Homestake Mining Co.; Utex Exploration Co.; Cal-Uranium Co., Pick Uranium Co.; Almar Minerals Inc.; and Rare Metals Corp., a subsidiary of El Paso Natural Gas Co.

Otto Herres, Salt Lake City, vice president of Combined Metals Reduction Co. and chairman of the National Lead and Zinc Committee, was named president.

The association also approved a report by Herres stating the Administrations lead - zinc stockpile goals had not yet been met. Repeal of the Reciprocal Trade Agreements Act of 1934; support of the Upper Colorado River Basin Plan and sliding scale royalties on Utah state school sections being developed for mineral wealth were urged.

Herres

The group noted that an action of the Utah State Land Board in asking immediate title to school sections in unsurveyed public domain may invalidate title to mining claims in those sections. It



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Utah *(Continued)*

asked clarification of the situation by both the state and the Department of Interior.

Critchlow Parsons, Dallas, Tex., president of Rocky Mountain Uranium Corp., claims his firm has a $1-million orebody —after mining costs—on Rainy Day claims, Circle Cliffs District, Garfield County.

The claims are located 1½ mi southwest of switchback access road built by AEC in the remote area, Parsons said.

Two 14-ton truck shipments have been made over wilderness roads to AEC's buying station in Marysvale District, Parsons reported.

Rocky Mountain Uranium reportedly is producing ore also at Upper Muddy claim group in Emery county, 12½ mi northwest of Floyd B. Odlum's Hidden Splendor (formerly Delta) Mine, purchased from Vernon Pick, Grand Junction, Colo.

Stockholders of Federal Uranium Corp. have voted to de-split stock 25-to-one and turn control of the firm over to W. L. Davidson Syndicate, Albuquerque, N. M.

Financier Floyd B. Odlum, New York City, is leading light in the syndicate. Action by Federal shareholders in late December resulted in Federal acquiring additional 50,000 acres in uranium mining claims in western United States and western Canada. The firm also received $170,000 in cash.

Mr. Odlum immediately launched into negotiations with several other small uranium companies with headquarters in Salt Lake City. A spokesman said: "We're interested in any claims with ore on them."

Paul T. Walton, Salt Lake City, who recently completed a world tour for Mr. Odlum in examination of uranium properties, was named president of Federal. He succeeds Reed W. Brinton, Salt Lake insurance executive, elected chairman of the board.

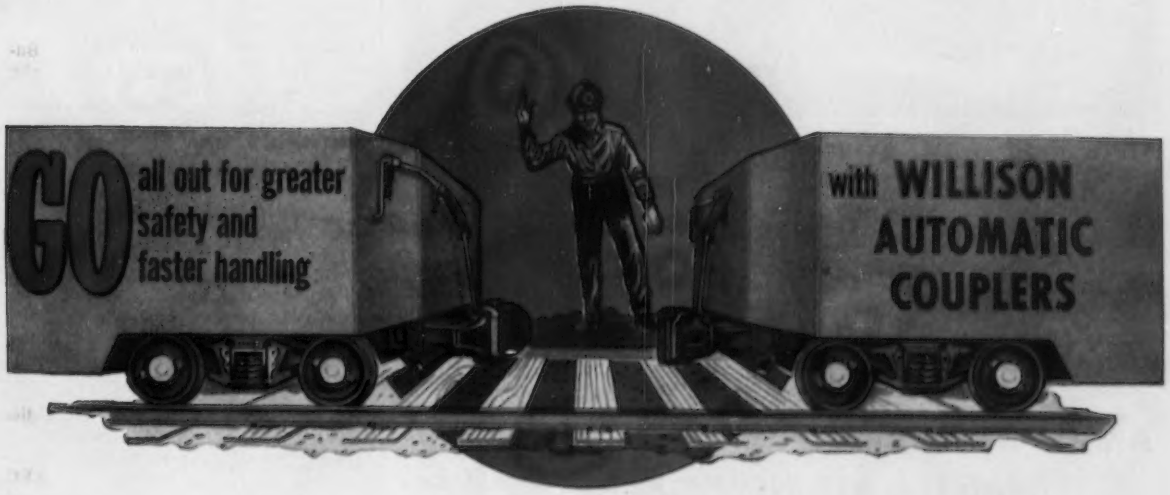
Vanadium Corporation of America has encountered an extension of the Freedom vein in uranium mining on the Bullion Monarch Uranium Co. lease, Marysvale district.

D. W. Viles, VCA vice president, said that "better than shipping grade ore" had been encountered. Size of the discovery on the Bullion property cannot be determined until lower levels are cut. VCA is using the shrinkage system in mining the lease, he added.

Radiore Uranium Corp. reported it had secured an agreement from S and S Cattle Co. to mine under the latter firm's bull pasture in the Indian Creek District, San Juan County.

James Downing, Radiore president, had earlier announced a "shipping grade find" on mining claims hear the cattle firm property.

S. and S, headed by J. A. Scorup, Moab, is one of the largest cattle firms in region—has heretofore resolutely refused to discuss mining propositions involving its free lands.



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Utah *(Continued)*

International Smelting & Refining Co. has announced commencement of stockpile of ore at its Tooele lead smelter in preparation for reopening in next few months.

Prospectors are facing a monumental assessment load on uranium claims filed during the continuing boom in western U. S.

Some 200,000 such claims have been filed during the last nine months in Utah alone, according to H. J. Vander Veer, minerals staff officer of Region II, Bureau of Land Management at Salt Lake City.

That would bring the bill in this state to $20-million.

Under Utah law, the prospector will enjoy a "year's grace" in which to complete assessment work.

If he files on claims on July 2, 1954, the work won't have to be completed until July 1, 1956.

In Wyoming, Colorado and most other western states, however, the assessment work is a part of the process of making location. And terms for completion vary from 30 to 90 days after moving on to the ground.

BLM will accept diamond and other type drilling, some access road work, ditching to develop towards discovery, as proof of assessment in most cases, Mr. Vander Veer said.

He noted, however, that proof of discovery is the best defense for legal ownership of claims.

Ore-buying schedule for the new AEC sampling plant at Moab has been announced by Sheldon P. Wimpfer, manager of the Grand Junction operations office. Construction has been completed and the station was ready Feb. 1, 1955.

Plant is operated by AS&R for the Commission. Uranium-bearing carnotite-type or roscoelite-type ores delivered to the station will be purchased in accordance with Circular 5, Revised.

Prior to opening the Moab plant, a provisional uranium ore-buying station was established in May 1954 to provide a market for certain ores mined in the area. Ore which has been accumulated on a provisional basis will be mechanically sampled in the new plant and final settlement made with the seller.

Major uranium orebody in the Moab area discovered and outlined in 1954 by a core drilling program of U&I Uranium Inc. is now ready for ore development and mining, according to company announcement.

Shaft sinking has begun and the property is expected to start production in mid-1955. Proven orebody is 2400 ft long and up to 1,000 ft wide, averages 700 ft below the surface and shows from 0.5% to 3.0% uranium.

Under a new agreement with Hecla Mining Co., Wallace, Idaho, Hecla will furnish all capital for developing and mining U&I's orebody and will manage the program, receiving 25% of gross income and absorbing 25% of all costs and expenses. U&I retains its interest in the balance and will also have initial drilling,

surveying, geological and other acquisition costs returned by Hecla.

Contract also provides for other associations in uranium operations in the immediate area, with Hecla conducting and financing all exploratory work and paying all mining expenses after which net profits will be divided 50-50.

4,462 tons of commercial grade uranium ore were mined by Continental Uranium Inc. during the firm's first quarter operations, according to Gerald L. Gidwitz, chairman of the board. November accounted for 1,936 tons, estimated by Gidwitz as the future production rate.

Bulk of the ore came from Continental No. 1, San Juan County. Second mine, the Rattlesnake, resumed production during October with 24 tons mined. In November, 498 tons were produced. Drill rig at Rattlesnake recently located 10-ft thick section of good ore, said Gidwitz.

New Idria Mining & Chemical Co., California quicksilver producer, has entered the Utah uranium race with purchase of mining rights to 40 acres of Navajo land in Monument valley. Contract, under which the tribe will receive royalties, is subject to Government approval.

New Idria plans to tunnel in 200 ft on an 18-in. thick outcrop. C. Hyde Lewis, vice president, described the ore as carnotite of "very good" grade. Charles F. Parker, New Idria president, is in charge of the operation. Contract for the tunnel was let to a local firm. Monument No. 3 will be site of development work.

Kennecott Copper Corp. expanded its Utah operation in December, adding 500 workmen to its payroll with the intention of increasing copper production by 6-million lb a month.

L. F. Pett, manager of Utah operations, said the work week was expanded from six days to seven. The expansion affects the big open cut mine in Bingham canyon, mills in Arthur and Garfield and the refinery in Garfield.

Outlining of a $50,000 orebody with substantial additional mineralization has been reported by Utco Uranium Corp. on two claims in the East Canon group near Monticello.

The claims are called the Windfall Nos. 27 and 28. Twenty-three of 33 drill holes found ore or mineralization.

A 370-ft drift is planned to reach the ore. Production is expected by April 1.

Formation of Vitro Minerals Corp., a joint affiliate of Vitro Corporation of America and Rochester and Pittsburgh Coal Co. for open pit mining or uranium ore in the Gas Hills District, Fremont County, Wyo., has been announced in Salt Lake City.

A joint uranium exploration project on the Colorado Plateau has been announced by the Texas Co. and the New Jersey Zinc Co. The announcement said that if deposits large enough to justify mining are found, a separate development company may be formed.

Utah State Land Board officials charged in Salt Lake City that vanadium and uranium are being mined on state land and

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BH-52-C

Utah *(Continued)*

that ore is being shipped without payment being made to the state.

Lee R. Young, manager, said such trespassing was suspected in Emery, San Juan and Garfield Counties, and that "we intend to do something about it."

Too many prospectors, he indicated, are operating on state land without going through the formality of getting a lease.

American Sulphur and Refining Co., Beverly Hills, Calif., was to complete construction of $1.1-million sulphur recovery plant at Sulphurdale this month. Plant utilizes new solvent process to recover sulphur from low grade. Process, licensed by Standard Oil of N. J., is used in metal refining, but has never been applied to sulphur because solvents were toxic and combustible.

Ten-acre refinery is expected to produce 100 tons of refined crystal-line sulphur per day.

Thomas Neale, president, says company will build similar plants in Peru, Mexico and Chile.

WASHINGTON

American Smelting & Refining Co. is continuing to operate the Van Stone open pit property in northern Stevens County on a marginal basis in the hope the price of zinc will rise. But a contract with the DMPA, guaranteeing a price of 15½c a lb, has been fulfilled and terminated.

Under terms of the contract, said J. E. Berg, general manager of Asarco's northwest mining department, the company was to produce 36,800,000 lb of zinc or earn $683,000 during its first 3 yr of operation.

The Van Stone company built a $2-million mine-mill plant and began operations during the fall of 1952. Full scale production of 1000 tpd came in March 1953, and the mill now handles about 30,000 tons of ore a month. About 70 men are employed. Some 30,000 tons of rock and overburden monthly also are being stripped from the deposit.

Addy Mining Co.'s tungsten mine, 15 mi west of Addy in Stevens County, being operated under a lease and purchase option by two Kellogg, Idaho men, Paul H. Floyd and Frank Birch, has had a drift extended on a tungsten vein under a $22,000 DMEA contract.

A 3-compartment raise is to be driven 110 ft up in the ore shoot from the main adit. If results justify it, a small plant for treating ore will be installed this spring.

Penticton Tungsten Mines Ltd., after making two shipments of concentrates from its mine near Springdale in Stevens County, has shut down for the winter because of freezing of ponds which supplied the water for the mill, Wellman Clark, secretary-treasurer, reported.

Work this winter will include installation of machinery to raise capacity from 300 to 400 tpd, and to improve recoveries.

O-B Hanger Puncture Strength Increased 10,000 Volts . . .

ANOTHER MILESTONE in the 50 years of O-B Hanger leadership has been realized with the recent increase in the electrical breakdown strength of O-B Hangers using Dirigo insulation. Previously well above the standard 7,000-volt test requirements, the puncture strength of Dirigo insulation has now been increased by 10,000 volts.

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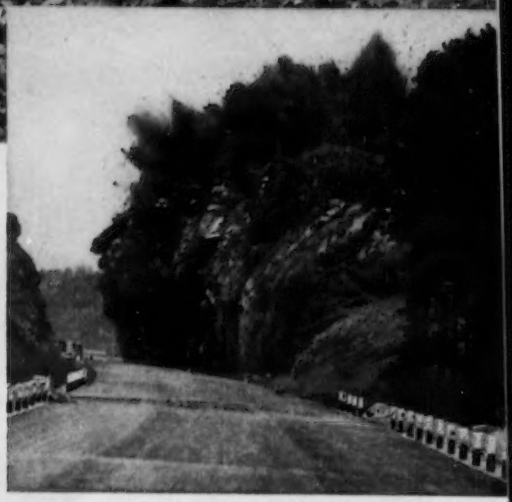

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A hill of hard, seamy granite 65 feet high, 100 feet wide, and 600 feet long, located between two sections of a new highway near South Billerica, Massachusetts, was broken to grade level on August 19, 1954, by the largest single blast ever made on a New England highway construction project.

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XR55-1

Washington *(Continued)*

Ore shipped came from above the main adit of the old Germania Mine.

Talisman Mining & Leasing Co. expected to start test drilling at its Utah uranium prospect last month. The Tindell group of 3 claims in San Juan County will be the site of the first holes. The company has a total of 20 claims in four areas of the Colorado Plateau and has engaged the Capitol Drilling Co. of Spokane, to do 10,000 ft of drilling.

A. E. Kaiser, Yakima mining engineer, who has leases on the Mohawk and Peacock mines in Okanogan County and the American Graphite flotation mill at Omak, reports that ore from both mines has been test-milled and a test shipment of concentrates has gone to the Bunker Hill smelter at Kellogg, Idaho.

With 2 months more of development work enough ore is expected to provide a 50 tpd production basis. At the Mohawk, a new 4-ft wide vein of reportedly high grade silver-copper ore was discovered by tunneling only 10 ft into a sheer zone from the old adit. Sinking is currently underway.

At the Peacock, Kaiser reported that the extension of a tunnel driven several years ago has opened a shoot of good milling-grade silver-copper ore.

Midnight Mines Inc., shipped its first carload of about 50 tons of uranium bearing ore from the Spokane Indian Reservation in Stevens County to the AEC's processing plant at Murray, Utah, Dec. 16. Among observers watching the loading were representatives of Anaconda Copper Mining Co. and of Phelps Dodge Corp. copper mining company with head offices in Douglas, Ariz., which is reported to have leased several thousand acres of state owned land north of the Reservation. The leases are said to be for 2-yr terms and renewable. Three more cars were being loaded late in December for shipment under an AEC contract calling for 200 tons in December.

Diamond drilling of test hole No. 1 which is being drilled at a 50 deg angle from the top of a ridge was reported down 176 ft in mid-December. No. 2 test hole is being drilled straight down from the top of the ridge. According to John C. LeBret, one of the discoverers, results from the first hole were inconclusive but a zone of mineralization was indicated. Testing is being done by the Bureau of Mines for the AEC. LeBret estimated that the first ore shipped would average about 38% uranium oxide.

Exploration work of the two LeBret brothers has been limited to surface bulldozing and blasting. Permits for prospecting are being granted only to members of the Spokane tribe. They are prospecting other parts of the reservation.

An unmined ore chimney will be tapped by a new two-compartment shaft sunk at the Gladstone Mountain Mining Co. in northern Stevens County.

The shaft is being dug by A. G. Lotze of Northport under a 2-year lease. In 1953 Lotze sank a 200-ft shaft uphill from the new one, which produced crude ore yielding 60 to 70% lead like that mined from the property in the twenties.

Lotze plans to sink the new shaft about 150 ft and then tunnel to the ore chimney. Work began in November and crews have gone down 60 ft.

Famed high-grade lead mine of World War I, the Electric Point Mine in northeastern Stevens County, has been purchased by the Northwest Mining Syndicate of Spokane.

The syndicate includes Fred M. Viles and J. S. Anderson of Spokane, and Fred O. Reynolds, Deer Park, Wash. They bought the property for an undisclosed sum from the estate of the late Maude Simonton of Colville. Viles, who is also president of the State Mining Co., which held a lease on the property, said the firm's interests had been turned over to the syndicate.

In the past two years, the Electric Point Mine has been rehabilitated for exploration, and a small amount of crude ore was shipped in 1954 by Harris & Bumgarner of Northport, mining contractors. The mine was a good producer of high-grade lead ore from chimney deposits during the years from 1916 to 1921.

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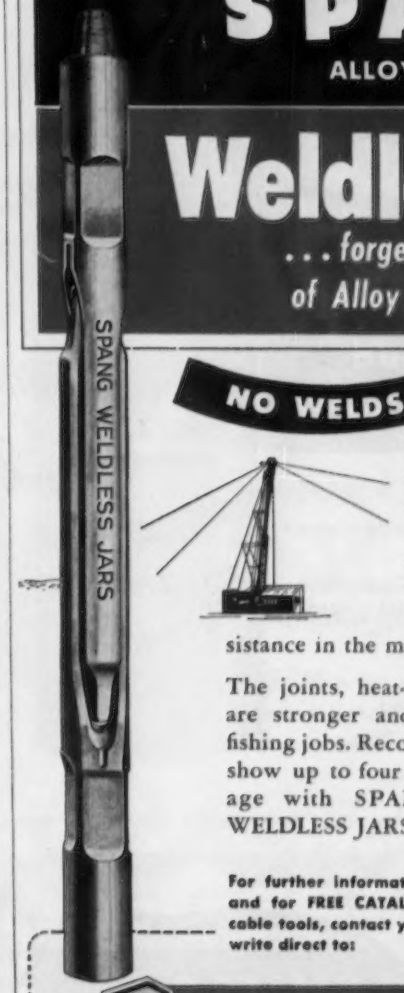

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Washington (*Continued*)

one from Warren and one from Tombstone, Ariz., have applied for leases on approximately 2700 acres of Washington state lands adjacent to the Spokane Indian reservation uranium discovery.

The applicants for mineral leases include officials and wives of Phelps-Dodge Corp. western headquarters at Douglas, Arizona. The applicants are: C. R. Kusell, general manager; W. C. Lawson, assistant general manager; H. Earl Moore, office manager; and E. E. Mailott, director of geophysics research.

Officials of Grandview Mines are listed as applicants for an area of 560 acres in the same district, filed between Nov. 26 and Dec. 8. They include: Ben H. Miles; M. H. Miles; Lawrence, M. J. and Rosemary Kroft; and William A. Stradley.

Under direction of the Atomic Energy Commission, the uranium ore on the reservation is being investigated for depth and commercial value.

WYOMING

U.S. Vanadium Corp. has opened a uranium ore buying station at Shoshoni, in Fremont County. Ore is being shipped to the USVC mill at Rifle, Colo.

American Smelting & Refining Co. was preparing to open its ore buying station at Riverton, also in Fremont County, early in February. Charles Bruner has moved to Riverton from Edgemont, S.D., to manage the new station.

Plans to establish an exploration office in Casper were announced in Denver, by Charles Towle, chief of the AEC's Denver production branch.

Exploration in Wyoming east of a north-south line running through Rock Springs will be controlled by the Casper office. Exploration in western Wyoming is supervised from Salt Lake City. AEC presently maintains an exploration office in Douglas.

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IN CANADA

QUEBEC

With most of the excavation work completed, it is expected that the big drainage project at the property of United Asbestos Corp. at Black Lake in the Eastern Townships will reach the start of water removal by May.

The project involves dredging the lake and diversion of waters flowing into it, in preparation for milling operations at a minimum rate of 5,000 tpd. Estimated cost of bringing the property to production is $20-million, the funds being provided by American Smelting & Refining Co. through its subsidiary, Lake Asbestos Corp. Mill construction should be completed by mid-1957.

O'Brien Gold Mines, veteran gold producer of the Cadillac area, is expected to close its doors some time this year. Exploration below the bottom level at 3,450 ft reportedly has failed to show encouragement, and the mine is being placed on a salvage basis. The company will not be going out of business, however. The management hopes to develop new properties.

A new ore zone has been encountered by Vendome Mines in first lateral work on the 500-ft level. The showing, known as No. 2 zone, lies north of the No. 1 zone, and appears to consist of two parallel veins carrying good values in zinc and silver.

No. 1 zone, being developed also on the 250-ft level, seems to be shaping up as anticipated.

Surface drilling on this Barraute area prospect gave the No. 1 zone a length of 900 ft averaging 7.25% zinc, 2.05 oz silver, 0.04 oz gold, and 0.45% copper across average width of 15 ft.

Gaspé Copper Mines, big Noranda subsidiary at Murdochville on the Gaspé Peninsula, has had a setback in its production start. The 31-mi power cable crossing the St. Lawrence River failed to operate effectively, and repairs can not be made until the river is clear of ice in the spring.

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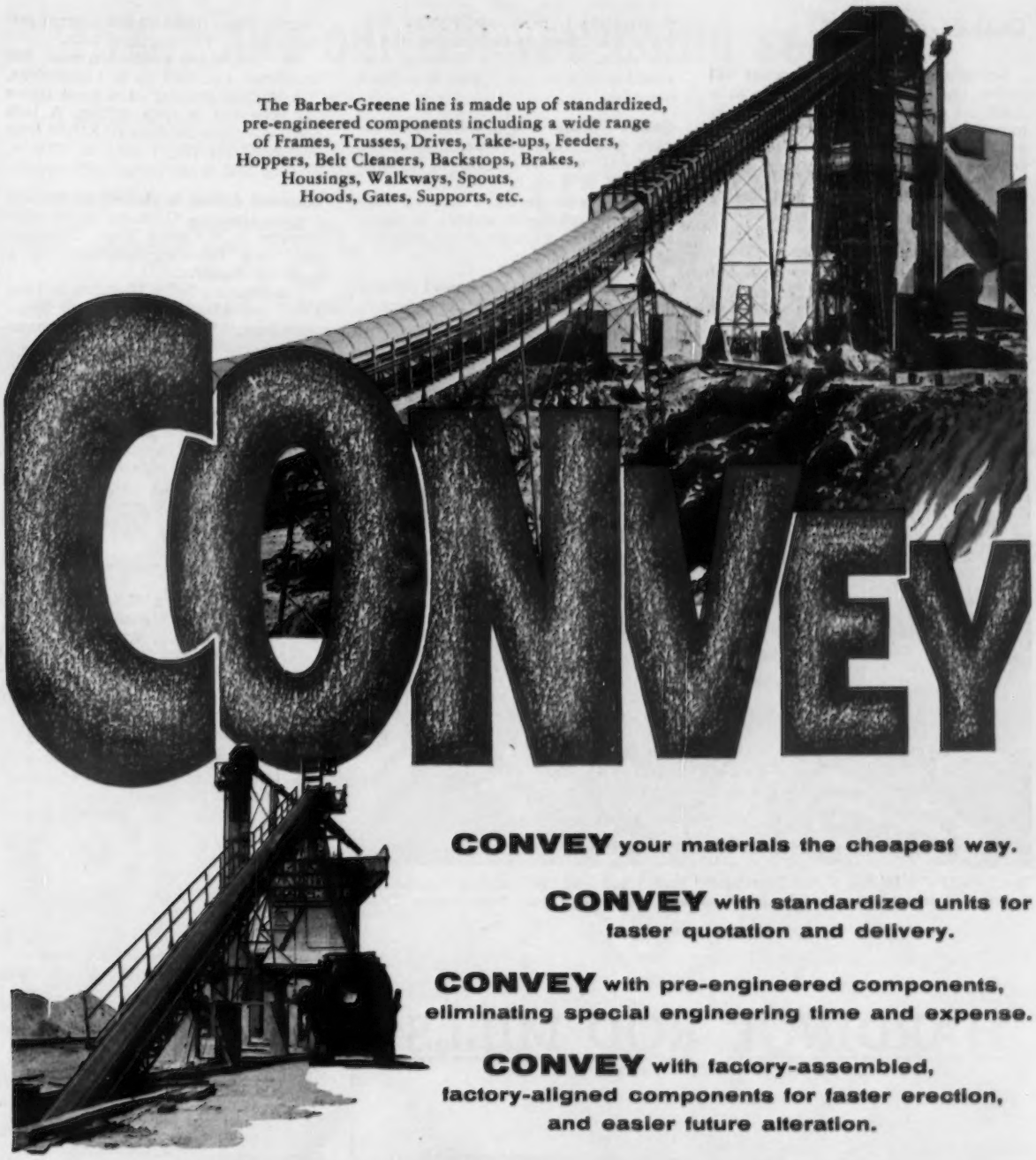

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Quebec *(Continued)*

Diesel and auxiliary steam power will enable the Gaspé mill to operate at a 2,000 tpd rate (installed capacity is 6,500 tpd) but the start of smelter operations will have to wait restoration of hydro power some time late in the year.

Underground development at Rainville Mines, Bourlamaque Twp., resumed last fall, is giving results. A flat drill hole put out from the west drive on the 550-ft level suggests a possible extension of 300 ft for the main No. 4 zone.

The intersection, on strike, showed 4 ft averaging 1.8% copper. Further drilling will be done on the showing, but in the meantime the drive is being continued toward the No. 2 zone, its primary objective.

Quebec Lithium Corp., potentially Canada's first lithium producer, has started shaft sinking on its property in LaCorne Twp., 25 mi north of Val d'Or.

The three-compartment opening, with permanent headframe already in place, is expected to reach its initial objective of 700 ft by June.

Mill expansion above the present 500-ton rate is expected this year for Opemiska Copper Mines (Quebec) Ltd., copper producer of the Chibougamau area.

The mine's first production year, just completed, has been up to expectations.

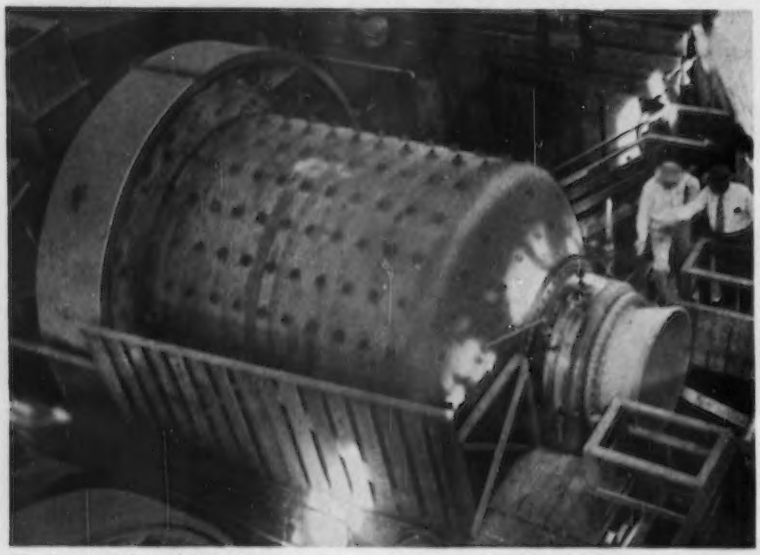
Additional promise of a good future has been had in deep drilling. A hole put down from the bottom (525-ft) level intersected the No. 3 zone at 1200 ft, showing 19.5 ft averaging 3.49% copper.

Diamond drilling is planned by Quedon Copper Uranium Corp. on its 18-claim property in McCorkill Twp., Chibougamau area, following completion of a geophysical survey.

The company holds 10 claims in Levy Twp., and 15 claims in Obalski Twp., same area. All three groups are copper-gold prospects.

Another company to arrange for winter drilling is Opawica Explorers Ltd., holding a base metal prospect in L'Esperance Twp., Bachelor Lake area, some 150 mi northeast of Val d'Or.

The ground lies astride the right-of-way of the railroad being built to Chibougamau.



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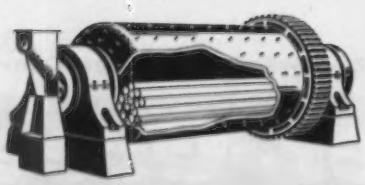

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ONTARIO

McKenzie Red Lake Gold Mines has completed its No. 5 shaft, an inclined opening that extends from surface to 2,250 ft on slope, or 1,650 ft vertical.

In addition to giving the mine bigger and more economical hoisting facilities, the new shaft gives the mine a chance to open four new levels.

Diamond drilling is in progress at the copper-nickel-cobalt property of Evenlode Gold Mines at Iroquois Bay on the north shore of Georgian Bay, north of Manitoulin Island.

Bulk sampling of the main zone last summer on surface across a width of 75 ft gave two tons of material that assayed 1.18% copper, 0.15% cobalt, 0.20% nickel, and 1.60 oz silver a ton.

Winze being sunk jointly by Coniaurum Mines and Central Porcupine Mines from the extension of Coniaurum's 5500-ft level has reached the 6500-ft horizon on its way to 6800 ft.

A station has been cut at 6500 ft to permit exploratory drilling, but main work will be at 6800 ft, where a minimum of 1000 ft of lateral work will be done. The winze is in Central Porcupine ground, but will be used to explore Coniaurum's depth chances as well.

Surface drilling will start shortly on a new iron ore prospect 30 mi northeast of Kapuskasing. The ground, nine claims in Howells Twp. and 27 claims in Clay Twp., was staked by interests associated with Hans Lundberg Explorations Ltd., following disclosure of two anomalies in aerial survey work.

It is expected that drifting will be in progress by March on the columbian-tantalum prospect being developed by Beaucage Mines near North Bay under the waters of Lake Nipissing. First level will be at 275 ft; the second at 425 ft.

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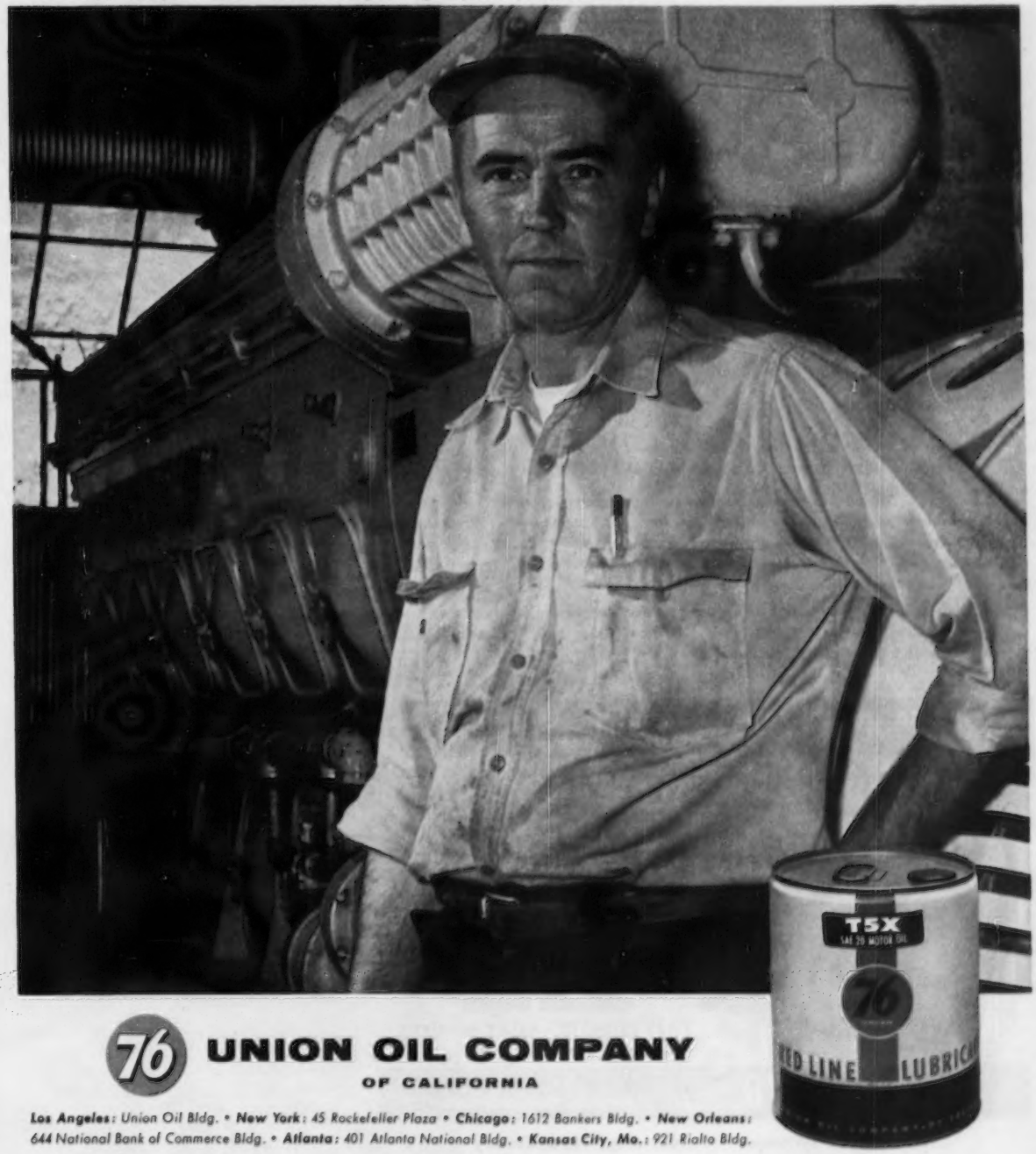
Ed Cox, power plant foreman, Wah Chang Mining Corp., Tempiute, Nevada



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Ontario *(Continued)*

to Consolidated Sudbury Basin Mines, with reorganization on the basis of one new for two old shares. The change has enabled the company to raise $3.25-million with which to resume development at its two-mine property in the center portion of the Sudbury Basin.

Immediate objective will be the doubling of copper-lead-zinc ore reserves from the present total of 10-million tons. Finalization of production plans, which will probably include a refinery as well as a concentrator, will depend on this.

Madsen Red Lake Gold Mines is going to deepen its shaft 1500 ft, taking the sump down from 2950 to 4500 ft. The project, to take 3 yr, will include enlargement of the shaft and its present hoisting capacity to make possible the handling of 1500 tons daily from a depth of 5000 ft or more.

Milling operations of Paymaster Consolidated Mines are being stepped up to a rate of 500 tpd. At year-end a rate above 400 tons had been reached by this long established Porcupine area gold mine, following resumption of operations in the early fall after a 10-month shutdown.

Sylvanite Gold Mines, old and steady gold producer of Kirkland Lake, has hopes in copper, having acquired Ontario's newest showing of the red metal. Located in Algoma, some 60 mi north of Sault Ste. Marie, the find aroused considerable interest, but little could be ascertained regarding it before snow fell; winter drilling is underway.

More than 2500 claims have been staked in the new Tashota base metals area east of Lake Nipigon and north of the transcontinental line of the Canadian National Railways.

Little is known about the area yet, most of the staking having been done blind following announcement that Teck-Hughes Gold Mines had acquired a large acreage to protect the copper showing discovered last fall. The Teck showing itself received only preliminary prospecting before the freeze-up, but plans have been made for extensive winter drilling. Some two dozen or more other companies hold ground in the neighborhood, but the intensity of their work will depend on the success encountered by Teck-Hughes.

Rare Earth Mining Corp., holding a uranium prospect in Monmouth Twp., Bancroft area, is planning to sink a 500-ft shaft. Considerable surface work and drilling have indicated a zone 1200 ft long and 8.6 ft wide, estimated to contain 1100 tons per vertical foot averaging 0.11% uranium oxide and 0.06% thorium oxide.

Stanleigh Uranium Mining Corp. Ltd., Toronto, affiliate of Standard Ore & Alloys Corp., New York City, has begun diamond drilling on its some 20 sq mi of properties in the Blind River District.

Contract for the diamond drilling went to N. Morissette Diamond Drilling Ltd., Haileybury, Ont. Program calls for preliminary drilling of 18,000 ft at a cost slightly in excess of $100,000 with a total of $250,000 earmarked to get "a true understanding of the deposit," reported Howard Steven Strouth, Stanleigh president. A permanent winter camp has been established.

BRITISH COLUMBIA

Value of British Columbia's mineral production for 1954 was $3,231,000 less than 1953. Mines Minister R. E. Sommers announced at year's end that B. C. mineral production for 1954 was valued at $149.5-million, compared to $152,731,000 the previous year.

"1954 prices received by B. C. producers of most metals were about 1% less than in 1953. Output of silver, copper, lead and zinc in B. C. increased moderately compared with 1953. Shipments of iron ore to Japan were reduced materially, but output of asbestos increased materially."

Another promising copper ore prospect is developing on Vancouver Island with Noranda reporting it has formed new company to explore and develop 27 claims on Comstock Mountain (near Quatsino Sound on north end of Vancouver Island).

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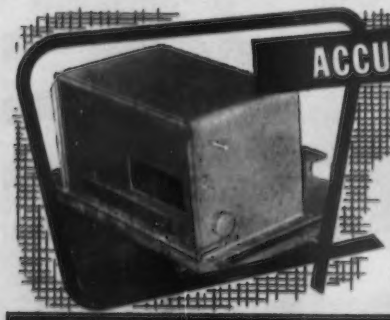

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British Columbia (*Continued*)

Exploration work with 6,000 ft of diamond drilling was undertaken during 1954 and results now being examined. Exploration will be resumed next season.

Some good intersections have been noted, and Noranda reports "1954 results added considerably to over-all picture."

To operate claims Noranda has formed Yreka Mines Ltd. with an Ontario incorporation. The claims (16 of which are reverted Crown grants) are 2 mi south of Pender Point on west shore of Neroutos Inlet, a southeast arm of Quatsino Sound. In charge of exploration is B. O. Brynelson.

Cowichan Copper Co. Ltd., president O. G. MacDonald has estimated ore developed at the property is now 300,000 tons averaging 6% copper.

Estimate has more than doubled since Nov. 20 as result of recent survey work by Dr. A. C. Skerl, consulting geologist.

The company (property near Youbou on Island) is shipping development and exploration ore to smelter at Tacoma.

Predictions are being made that the next big Canadian mining story to be unfolded will be about the big lead-zinc deposits at Pine Point in North West Territories, presently being explored and developed by Cominco and Ventures interests.

Reports to date indicate results in recent months have surpassed expectations, multiplying both tonnage and grade.

Full ownership of the claims which it has held for some time adjoining Canadian Exploration Ltd., near Salmo, B. C., has now been acquired by Victory Tungsten Ltd. Final payment of $22,500 cash was made to conclude deal.

R. Hodson, president, informed annual meeting steps are being taken to have the claims Crown granted. Little work has been done on the ground since diamond drilling was suspended late 1953. Indicated ore, as estimated from drilling, is calculated at 200,000 tons average 0.4% tungstic oxide.

Two showings of high grade ore have been uncovered in surface work at property of Silver Standard Mines near Hazelton in B. C.'s Omineca mining division. Both are at 1400-ft elevation. The first, 100 ft long, averaged 57.2 oz silver, 0.126 oz gold, 4.6% lead and 1.6% zinc across 1.25 ft. The second, stripped for 35 ft, shows higher values across narrower width.

Big Bend section of B. C.'s Columbia River is shaping up as one of Canada's kyanite sources.

Satisfactory flowsheet has been developed for recovering kyanite and its associated muscovite and garnet from deposits in the Big Bend; and from Mattawa and Sudbury in Northern Ontario.

Development of Canada's kyanite sources could make the country independent of present foreign sources and would provide a basis for new ceramic industries, researchers state.

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British Columbia (*Continued*)

Granby Consolidated is expecting to do at least twice as much work at its Granduc Mines this year as in 1954, with a $700,000 development program now underway.

Granby (together with financial partner Newmont Mining Corp.) has lined up for the big new copper project located 550 mi north of Vancouver, a three-way development which includes extension of present adit at elevation of 3250 ft. Another adit will be started to explore upward extension of the ore-bodies 500-ft higher up the mountain. Then some very deep diamond drilling will be undertaken by reaching as deep as 2000 ft below present adit level.

Unofficial estimates of over-all tonnage potential now range up to 20-million tons.

Granby Consolidated has signed an agreement with Mine-Mill union at its Copper Mountain operation, which provides only for a wage increase of 3% across the board (equivalent to 40c per shift). No additional fringe benefits were incorporated in the new agreement.

Deer Horn Mines crews report that ore has been intersected in No. 1 adit being driven at its gold-silver property in Kitimat area (85 mi southwest of Burns Lake). The company reports the crosscut entered ore at a point 171 ft from the portal and was still in the same material at 195 ft.

Consolidated Discovery Yellowknife Mines Limited established a Canadian record for lode gold mining with a month's production of 8599 oz of gold valued at $291,000 from 3115 tons milled. Recovery was 98.65%. Average grade of ore milled was at 2.78 oz, $97.30 per ton.

The outstanding grade for the month was due mainly to development ore from the North zone vein at the 1700-ft level, according to company report. The North zone has shown a rapid increase in grade with depth in the block of ground under development. On the 1400 level, grade is 2 oz per ton for a length of 150 ft and width of 6.4 ft. On the 1550 level grade averages 3 oz per ton for length of 140 ft and width of 6.8 ft.

Biggest surplus sale by private industry will take place with disposal of equipment and material from the first phase of Alcan's Kitimat project, completed a few months ago. Shovels, cranes, motors, generators, drills and a mountain of small equipment will be disposed of, including trucks, tractors, and helicopters. S&S Machinery Co., of New York, is in charge of the sale.

NEW BRUNSWICK

American Metal Co., with 10 surface drills in operation on its big copper-zinc property in the Bathurst-Newcastle area (see *E&MJ*, December 1954, p 116) continues to expand its ore potential.

Nothing has been given out regarding

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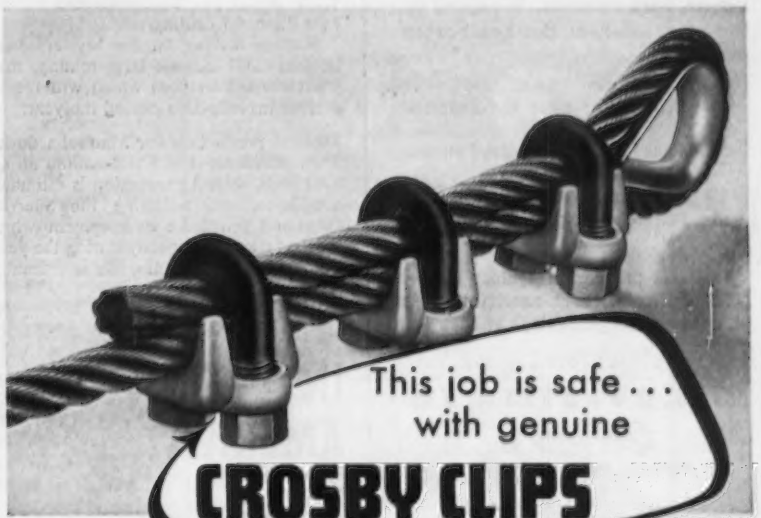

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New Brunswick *(Continued)*

results since last fall's estimate of 3-million tons of high grade lead-zinc ore and 1-million tons of copper ore, but there is no question that a much larger tonnage will be carded when annual report time comes around this spring.

Bathurst Mining Corp. and Maritimes Mining Corp., on a 50-50 basis, have acquired 11 groups of claims in the general area of the American Metal property. The holdings total 885 claims, or approximately 35,400 acres. Extensive exploration work is planned for the coming year, and a geophysical survey has already been completed on one group south of AMCO on which intriguing anomalies are indicated. Diamond drilling is to be started immediately.

MANITOBA

Canadian Nickel Co. Ltd. exploration subsidiary of International Nickel Co. of Canada plans large-scale investigation of nickel ore prospects in the Moat-Mystery Lake area of northern Manitoba.

Since 1947 the Company has conducted extensive air and ground geophysical surveys along the Hudson Bay Railway and has staked and acquired large blocks of mining claims in the Mystery Lake area.

Present plans call for shaft sinking to 1300 ft and underground investigation of the Moat Lake occurrences where it is reported that 50-million tons running 0.7% nickel has been indicated by surface diamond drilling.

Surface drilling on the Mystery Lake holdings also indicate large tonnage marginal ore occurrences which will receive further investigation during the year.

Mineral production for Manitoba during 1954 is estimated at $34.8-million an all-time high. Metal production is estimated at $20-million, reflecting the Sherritt-Gordon Lynn Lake development which reached its rated capacity during the year. Value of industrial minerals is estimated at $9-million.

IN LATIN AMERICA

MEXICO

Cia. Industrial Minera Occidental, S. A., (CIMOSA) has renewed operation of its lead smelter at Urias, Sinaloa near the seaport town of Mazatlan. This smelter, with a capacity of about 100 tpd, will receive ores and concentrates from the Mexican west coast States of Sonora, Sinaloa and Nayarit.

Several small flotation mills have been placed in operation recently. Among these are: Cia. Beneficiadora y Minera de Copala, 50 tpd at Copala, Sinaloa; Explotadora de Minerales, S. A., 30 tpd, at Ocoroni, Sinaloa; Cia. Beneficiadora de Minerales La Zacatecana, S. de R. L., 35 tpd, Zacatecas, Zac., and a 25-tpd unit operated by Cia. Minera El Fenix, S. A.

During 1954 there was placed in operation at Zimapan in the State of Hidalgo a lead smelter operated by Messrs. Langenscheidt and Ramsden. This smelter has a reported capacity of 50 tpd, and smelts oxide ore from the well-known Lomo de Toro Mine. Name of the company is Negociacion Minera Lomo de Toro.

Flotation mill of Cia. Minera y Beneficiadora de Sombrerete, S. A., at San Martín, near Sombrerete, Zacatecas, also began operation in 1954. This mill is treating sulphide ores containing silver, lead, copper and zinc. The mill now has a capacity of between 150 and 250 tpd.

A third flotation mill to come into operation during 1954 was that of Minas del Rio Mayo, S. A., at Distrito Rayón in the State of Chihuahua. This plant, which is treating silver ore, has a 50 tpd capacity.

Operations are said to be going very well at the Waelz fuming plant of Zinc Nacional, S. A., at Monterrey, N. L. This plant began operation in 1953 and now handles about 2,800 tons per month of oxide zinc ores, producing zinc nodules assaying about 68% zinc. These nodules are sent to the U. S. for reduction.

First shipment of processed sulphur from Texas International Sulphur Co.'s autoclave plant near San Felipe, Baja California, arrived Dec. 9 in Mexicali. The initial 150-mi shipment, by truck, was made under a long-term agreement by which Texas International's subsidiary, Azufre, S. A., will sell the entire output of its San Felipe plant to a Mexicali insecticide manufacturer. Anticipated annual production is about 7,000 tons, according to Victor Dykes, Texas International president.

CHILE

Sali Hochschild, S. A., well-known Chilean mining enterprise, is about to finish a 20 tpd 98%-contact sulphuric acid plant at Copiapo, capital of Atacama Province.

This acid will supply the solvent for the company's two slime plants at the same site.

The acid plant was built and supplied by Lurgi Gesellshaft Chemical Engineering firm from Frankfurt am Main. Of the two slime plants, one is being constructed at the present time and will treat both custom ores and ores supplied from the firm's own mines. Thus a new outlet has been found for the low-grade oxidized ores that could not previously be concentrated or smelted. Copper in these ores will be transformed into a 75% cement.

Present price of copper permits the Mining Bank to pay good schedules for copper ores, concentrates and precipitates.

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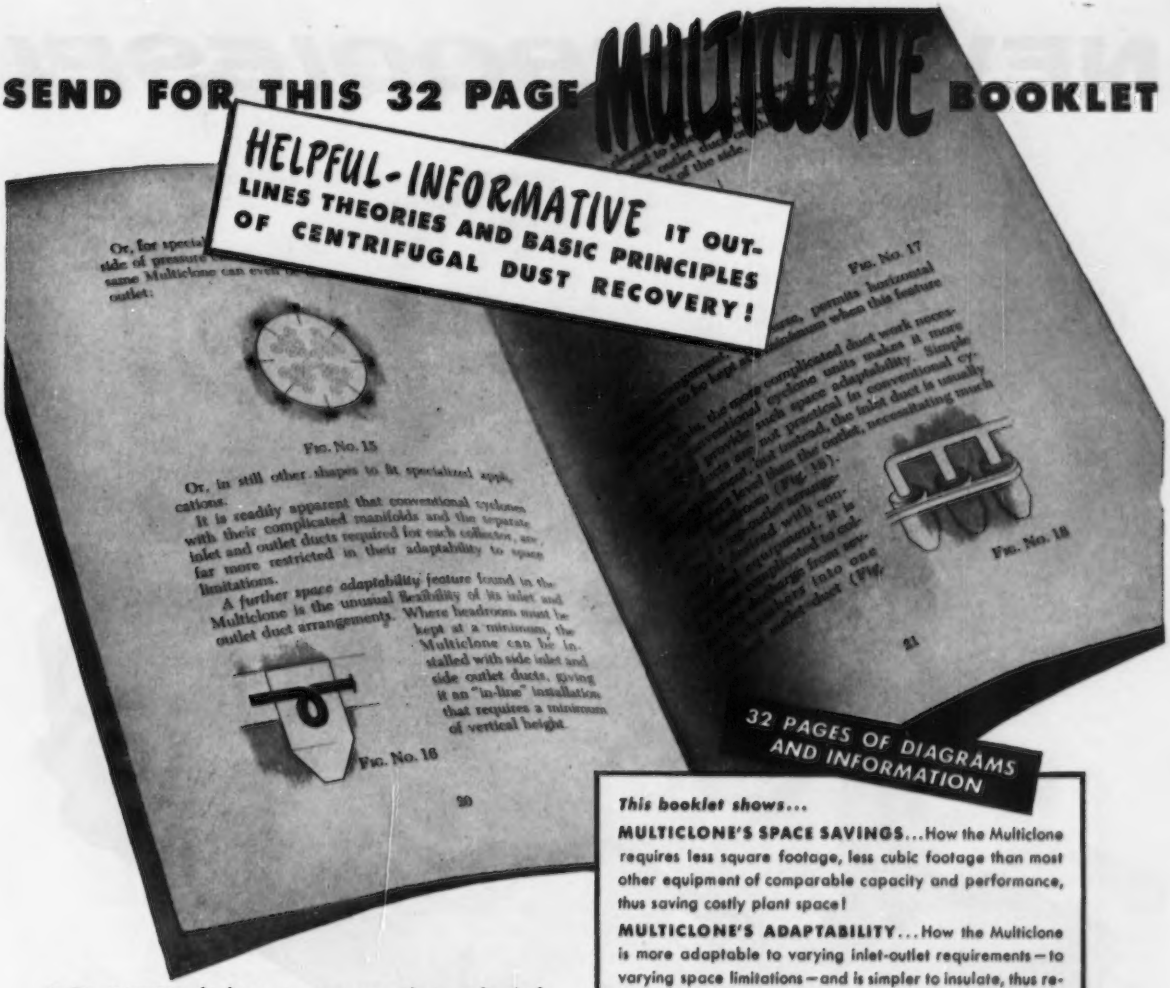

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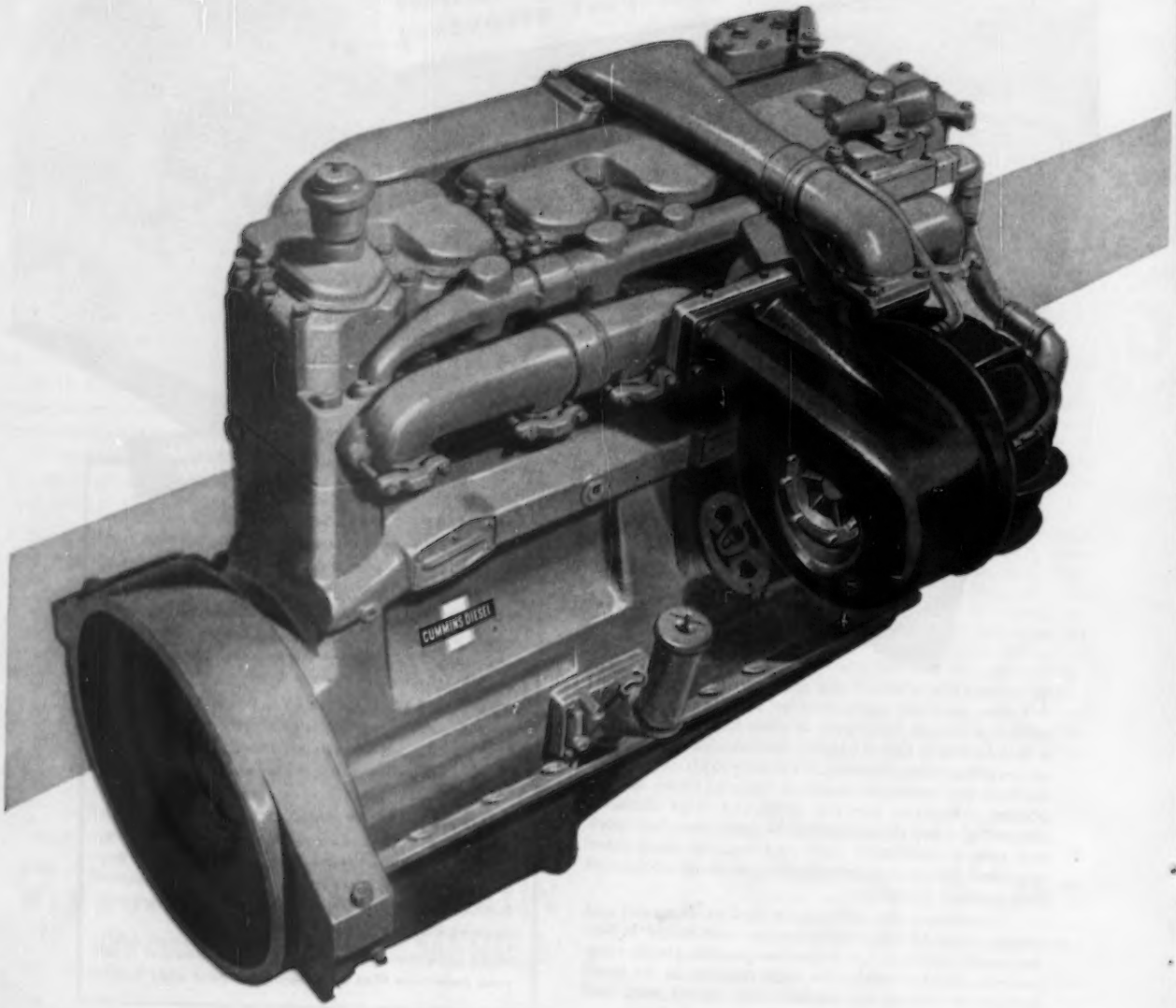

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MIANRAI TEORANTA, the Government of Ireland mining company, has since 1948 been exploring copper deposits at Avoca, Co. Wicklow, by tunnelling and underground diamond drilling and surface diamond drilling.

These deposits were worked from 1790 to 1810 and again from 1840 to 1917. The mineralized belt extends over a strike length of five miles, in an Ordovician formation. The old mines are confined to half of this distance, divided by the Avoca River — East Avoca and West Avoca.

The proved and probable ore reserves as at present defined are as follows:—

WEST AVOCA.	TONNAGE	GRADE	
		Copper %	Lead %
South Lode	9,000,000	1.07	0.03
Pond Lode	2,700,000	1.35	0.19
	330,000	1.11	0.05

West Avoca. (Cont.)	GRADE	
	Zinc %	Sulphur %
South Lode	0.24	5.30
Pond Lode	0.60	16.40
	0.30	21.10

EAST AVOCA.	TONNAGE	GRADE	
		Copper %	Lead %
East Cronebane Lode	1,700,000	1.18	1.05

East Avoca (Cont.)	GRADE	
East Cronebane Lode	Zinc %	Sulphur %
	1.58	10.6

The Company's scheme of exploration has been largely confined to West Avoca, representing one-third of the mineralized area.

The orebodies dip at an angle of about 50 degrees and vary in thickness from 25 to 90 feet. The reserves in West Avoca lie between 300 feet and 1,000 feet below the surface. At 1,000 ft. the deposit maintains both grade and width.

Avoca is situated forty-four miles from Dublin, and the mines are already provided with rail, road and housing facilities.

The Irish Government, who own the deposits, is interested in the commercial development of Avoca on a rational basis so as to provide a stable industry.

All enquiries should be addressed to:—The Secretary,

MIANRAI, TEORANTA,
FOUR PROVINCES HOUSE,
48, Harcourt Street, Dublin, Ireland
Telegrams: Mianrai, Dublin
Telephone: Dublin 52398

Chile *(Continued)*

This has made possible the installation of many small flotation plants which use Chilean mills as grinding units and flotation cells locally made.

Most of these mills treat between 10 and 30 tpd and sell their concentrates to the Paipote smelter for which the Mining Bank does the buying. In Antofagasta Province, where the zone of oxidation reaches great depths, small leaching plants have been constructed.

To supply these small plants with acid, CORFO (Chilean RFC), is building a 30 tpd 98% contact sulphuric acid plant at the port of Antofagasta which also has been supplied by Lurgi.

Therefore, the small miner can find at the present time an outlet for all types of copper ores: if above 6%, he can sell them to the Paipote smelter for direct smelting; if below this grade and sulphides, they can and are concentrated in small plants using locally-made Chilean mills and flotation cells and if oxidized he can leach them by percolation in crude plants precipitating with scrap iron.

Cia. Minera Tamaya, a well-known Chilean company which produces gold, copper and mercury from its mines and mill at Punitaqui, Coquimbo Province, has been developing an interesting copper deposit known as Las Chivas near the shores of Lake Buenos Aires in Aysen Province where this company has been pioneering mining developments through its subsidiary, Cia. Minera Aysen, already a producer of pig lead and zinc concentrates.

Las Chivas is a massive chalcopyrite-magnetopyrite vein running 12% copper. Lake Buenos Aires is about 6 hr flight south of Santiago and is half in Chile, half in Argentina.

Corporación de Fomento de la Producción—CORFO—has created a geologic division, which will be in charge of research and studies undertaken in Chile, destined to establish the existence of mineral deposits.

Division will be financed with funds from the CORFO's budget and Point Four. Early this year, a mission of U. S. experts and geologists will arrive in Chile to start the respective exploration work. The division will draw up a five-year work plan, in which emphasis will be on search for petroleum and radioactive minerals.

With talks under way for an initial purchase by India of 10,000 tons of sulphur, there is great activity in the mining establishments of Compañía Azufrera Nacional, which operates the Villa Industrial plant, situated at the foot of the Tocaro volcano.

After a prolonged recess, resulting from lowering of prices and postwar weakening of the world sulphur market, in the face of a marked increase of the value of sulphur, production is now being intensified in all sulphur deposits of the Province of Arica.

Brimstone producers have been hit hard by competition from Frasch sulphur and rising costs brought about by inflation.

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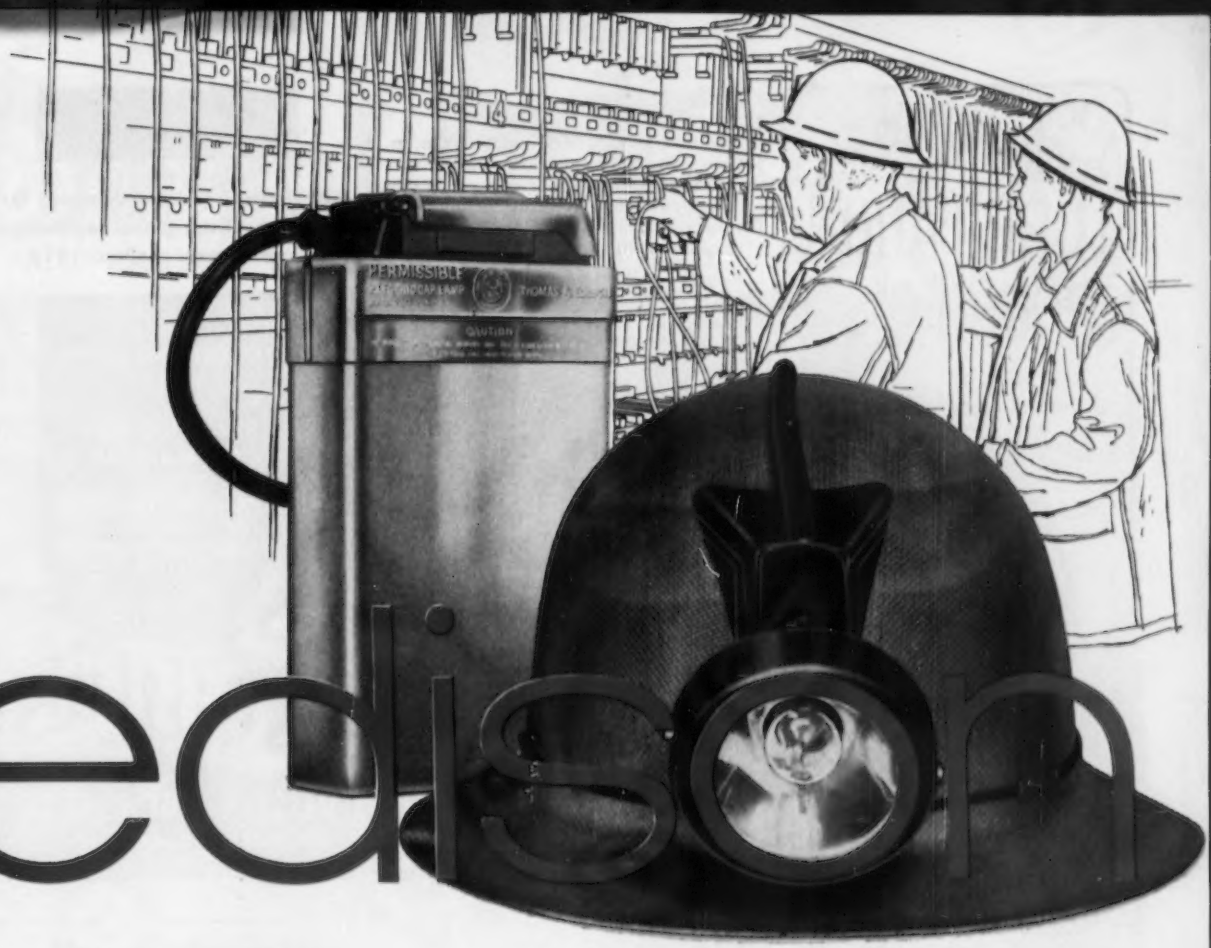

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Chile *(Continued)*

Flotation to a 85-90% sulphur concentrate followed by autoclave or centrifugal processing seems, in the opinion of one mining consultant, to be the metallurgical answer to the riddle of treating Chile's volcanic sulphur ores.

Paipote smelter continues to produce about 1,250 metric tons of blister copper a month which are refined under contract by the Norddeustche Affinerie in Hamburg, Western Germany. This smelter soon is to install a new Babcock & Wilcox boiler to supplement the boilers already installed.

PERU

The Marcona Mining Company, formed by the Utah Construction Co. and the Cyprus Mines Corp., which started shipments from the Marcona deposits some 500 km south of Lima on April 30, 1953, has considerably increased production and it is expected that shipments will reach an annual rate of 2-million tons in the near future.

According to figures released by Marcona, total shipments from April 30, 1953, to Dec. 31, 1954, were 2,845,030 tons carried in 274 ships and consigned to the U. S. Steel Corp. in the U. S. In the first full year of operations, from Jan. 1, 1954, to Dec. 31, 1954, total shipments were 1,897,501 tons, carried in 183 ships.

ARGENTINA

Dirección Nacional de Mineria has signed a new agreement with the University of Cuyo for the examination of several mining areas in the provinces of San Luis, San Juan and the Territory of Neuquén. About 1.8-million pesos will be spent in the investigation of some sulphur, tungsten, copper and magnesium deposits. By the same agreement an experimental cyanidation plant will be put in operation in Agua Tapada, Catamarca to test the gold ores of Farellón Negro.

Castaño Viejo, lead and zinc mine developed by National Lead Co., will be in full production by the end of 1956. It has been decided to erect the 200-ton flotation plant near the mine instead of down the Castaño River. Water will be pumped up some 1800 ft. Construction of high tension lines, auxiliary roads and housing commodities for 200 families are well advanced. Machinery for a value of $1.9-million is on the way from U.S. Installations will be by Southwestern Engineering Co.

Empresa Minera Los Marayes, formerly Piccardo y Cia., will start the exploration of its mines El Azufre and Fabulosa. A project for 1500 mi of drifts and raises has been included in the cooperation plan of the Dirección Nacional de Mineria for 1955.

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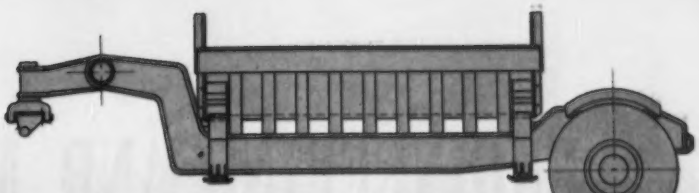

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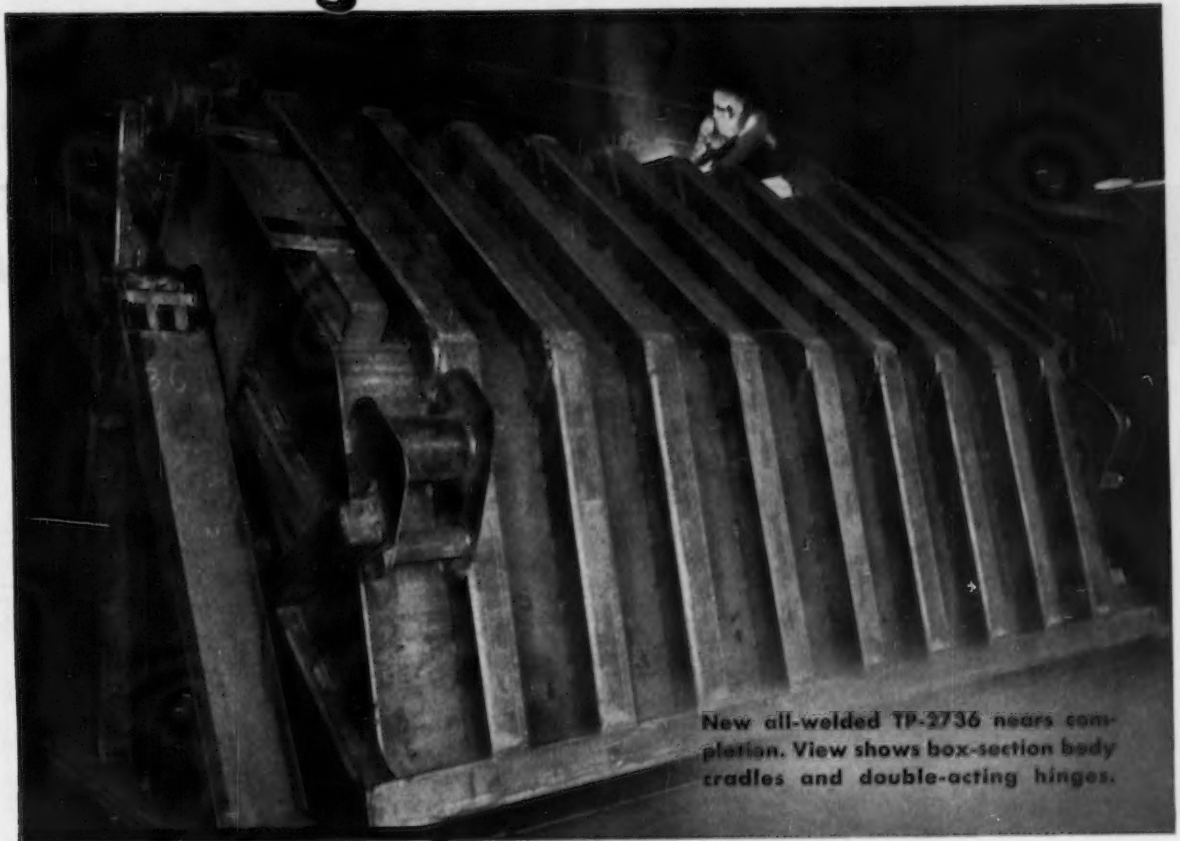

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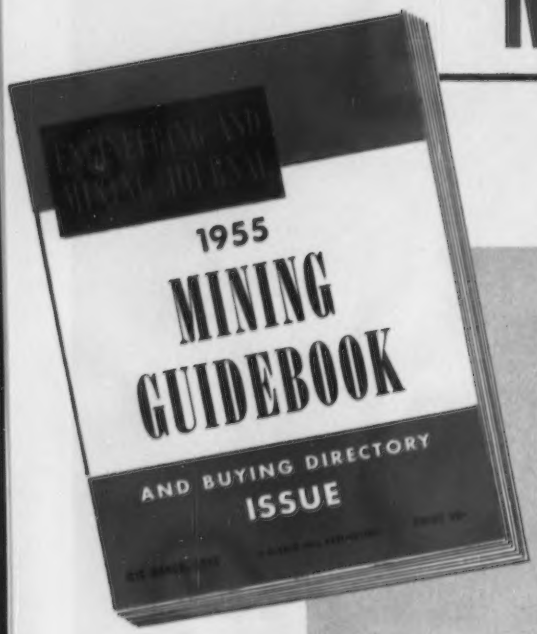

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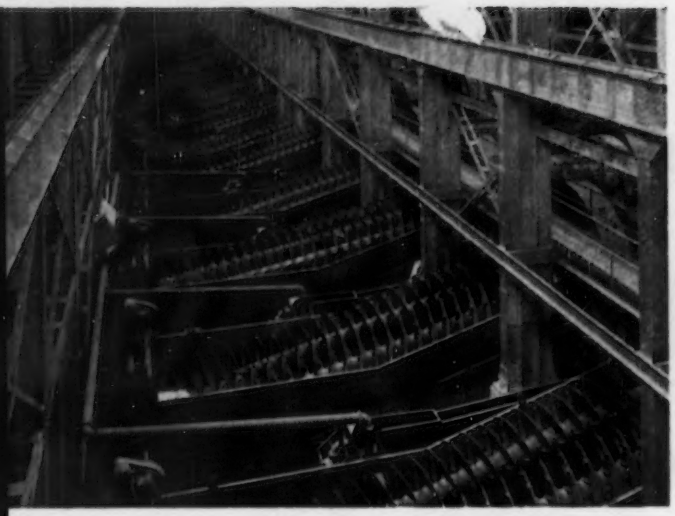

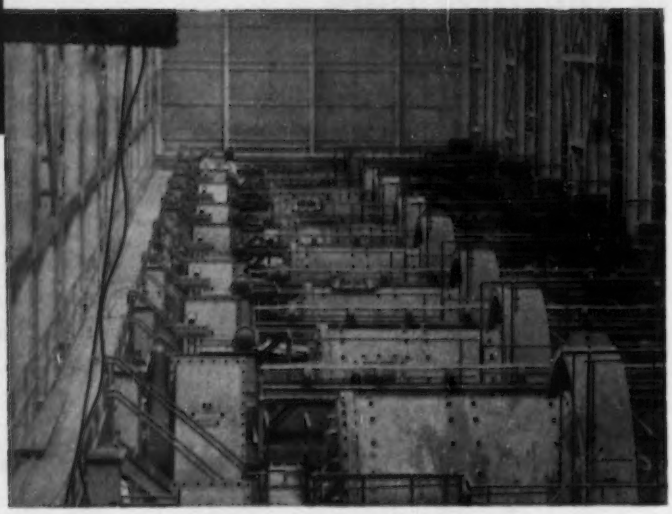

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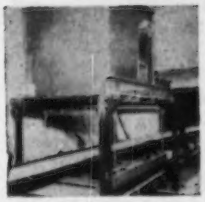

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WORLD'S LARGEST MANUFACTURERS OF PORTABLE RADIATION INSTRUMENTS

Argentina *(Continued)*

cableway has been constructed by the Dirección General de Fabricaciones Militares (General Administration of Military Factories) in its mine in the Province of Salta.

Work was started in October 1952, and completed in January 1955. Investment in the new cableway totals 17½-million pesos. The cableway, purchased in Great Britain from "Brecco," will now permit transportation of the sulphur from the mine to the "La Casualidad" mills at Caipe more economically and rapidly than previous truck hauling, over a rugged zone from the mine's 5200 meter high level to that of 4200 of the plants.

Rio Diamante, S.A. mining firm, working lead, zinc and arsenic deposits near San Rafael, Mendoza, equipped with a concentration plant and cableway, this March will install a flotation plant and, apart from lead and zinc concentrates, are starting to produce enough arsenic to make Argentina self-sufficient.

The company's basic investment in the deposits and concentration plant amounts to approximately $500,000, and its new investment in the flotation plant totals some $200,000. The plant equipment is mostly Western German.

No official statistics are available for imports of arsenic, but it is estimated that they vary between 1500 and 2000 tons yearly.

Cia. Minera Campana Nahuida, mining lead and silver in Loncopue, Neuquén, has been granted a 10-million peso loan by the Industrial Credit Bank (Banco de Crédito Industrial), to be invested in modernization and expansion of its installations. Most of the credit will be destined for the purchase of locally made equipment and materials.

Main item of its program, which went into effect last month, is installation of a concentration plant with a 100-ton daily capacity, and construction of a dam for electrification of the project.

Investigations are being intensified in the Province of La Rioja, where important asbestos deposits are claimed to exist. The zone, known as Bolsón Jagüe, is 3500 meters above sea level.

Small quantities of short-fiber asbestos are already being produced in nearby zones, as well as in the Province of Catamarca, which is sold in powdered form.

Argentina is presently importing some 1500 tons yearly of long-fiber asbestos, Canada being the main supplier. Because of its scarcity and importance for local fiber cement industry, importers are given the "preferential" rate of 5 pesos to the dollar, as against present free rate of 27.00.

BRAZIL

Minerals figure importantly in a new trade treaty signed by Brazil and Poland covering exchange of US$8-million in merchandise, half to be supplied by each country.

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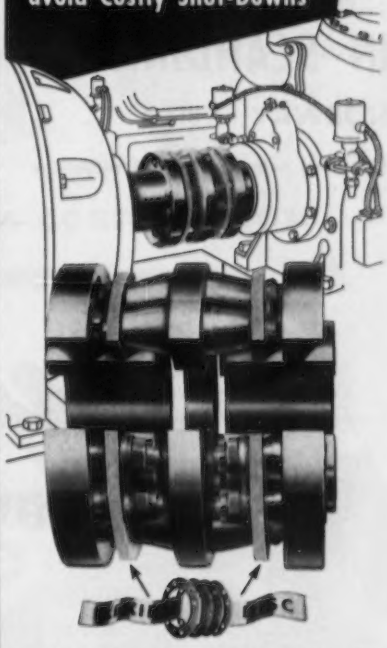

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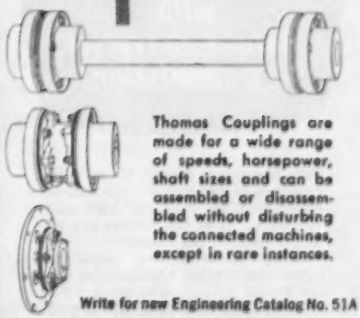

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THOMAS FLEXIBLE COUPLING CO.
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Brazil *(Continued)*

Included in the agreement is $2.2-million worth of iron ore from Brazil and $500,000 of mining machinery, $100,000 zinc oxide, $300,000 soda ash, and $50,000 of lithopone from Poland.

IN SCANDINAVIA

NORWAY

Aluminum output in Norway suffered a hard blow when ovens of the new Aardal & Sunndal Verk were shut down in November because of electric power shortages.

About 18,000 long tons of aluminum were trimmed from the company's production schedule, bringing a loss of nearly $8-million in foreign exchange to this country, it was reported.

Aardal & Sunndal had 88 ovens already in use and had expected to place 176 new ovens into operation in November. Instead, the company reportedly was asked to cut down to 40 ovens.

Power shortage was ascribed to lack of rain in northwestern Norway mountains. It was expected that the power shortage will remain until the spring thaw.

Sale in advance of 750,000 tons of iron ore from 1955 production of A/S Sydvaranger has encouraged company officials to plan record production this year. In 1954, Sydvaranger produced 668,000 tons of ore.

Between 150,000 and 200,000 tons will go to Britain and the rest to West Germany.

A/S Sydvaranger, which operates Norway's largest and northernmost iron ore works, located at Kirkenes, will drain the nearby Bjornevann lake to make several more million tons of ore accessible for mining. Preparatory work has already been started on a 5-mi conduit to connect the lake with Langfjord. Since the war, surveyors have made some 10,000 diamond borings to determine the extent of the Bjornevann deposit.

Farther south, in the Dunderlandsdalen valley of North Norway, the company has ascertained the existence of very extensive iron ore fields by making altogether 45,000 borings. The Dunderland deposits are believed to be even larger than those in Sydvaranger.

FINLAND

Finland will import 15,000 tons of iron ore and 1000 tons of aluminum from Norway under a new trade pact signed in Helsinki recently. The new agreement calls for exchange of $12-million worth of goods during 1955. Annual trade between the two nations heretofore amounted to about $7-million. Finland will export chiefly timber, machinery and paper products.

Finnish Ministry of Industry & Commerce has awarded bonuses of a total value of 500,000 marks to geologists who have discovered molybdenum deposits in two areas of northern Finland. At the same time, the Ministry urged a continuing search.

IN EUROPE

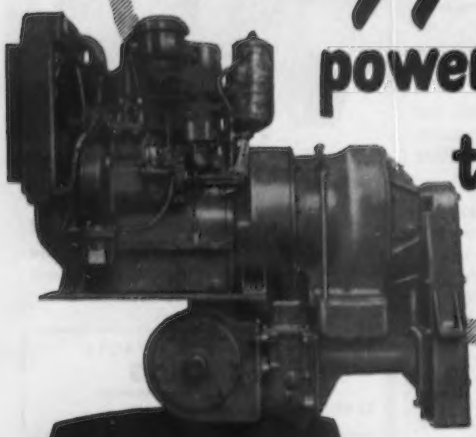
AUSTRIA

Nationalized Stickstoff Werke (Nitrogen Works) of Linz, Upper Austria province, recently began production in its new sulphuric acid department, planned in view of the large deposits of gypsum on hand. The Linz plant is one of the few in the world which uses gypsum instead of pyrites and sulphur as raw materials for producing sulphuric acid.

FRANCE

French gold-mining company, Mines de la Belliers, has discovered what is said

Sheppard powers "G-E" trammer



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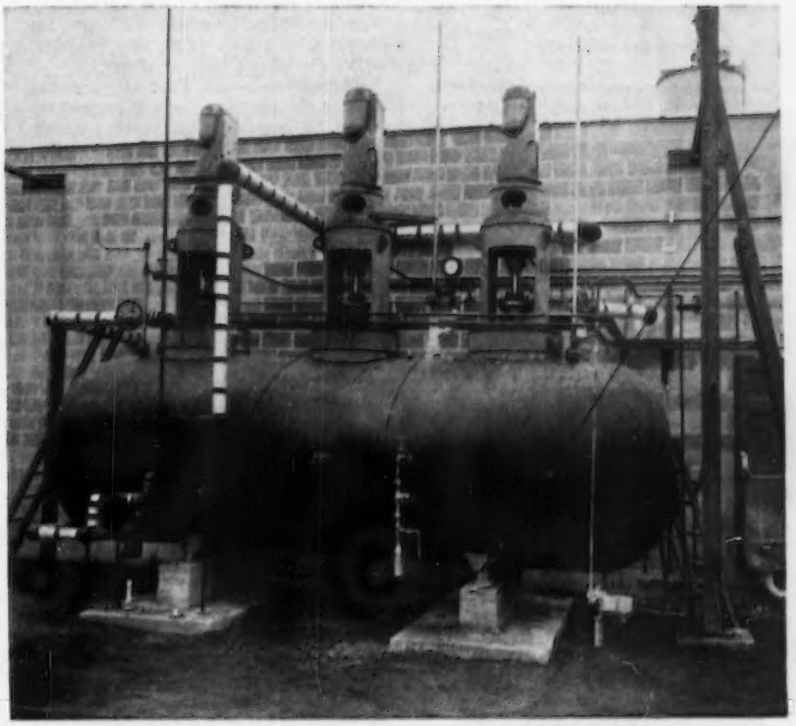

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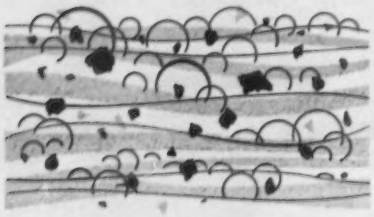

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WORLD'S LARGEST MANUFACTURERS OF PORTABLE RADIATION INSTRUMENTS

France *(Continued)*

to be a "revolutionary" process for recovering gold from ore waste. According to well informed circles, the method will shortly be applied in the U. S. under license from the French company.

Gold mine at Salsigne in southern France, one of two French gold mines, will start working again. The mine, which will re-employ 350 of its normal 1,200 workers, closed down last February because of a fall in the price of gold made it no longer profitable.

GERMANY

Uranium deposits being explored near Bayreuth are said to be richer than those in East Germany and Czechoslovakia. Careful exploration in the Fichtel Gebirge mountains in northern Bavaria has shown great radioactivity, with final limits still unknown, say observers.

Operations at the East German site at Erze Gebirge are centered around the towns of Aue and Johanngeorgenstadt, where between 80,000 and 100,000 men are said to be employed.

POLAND

First ore from the newly opened Boleslawiec mine reached the surface during October 1954. This is the first completely new copper mine in Poland since the end of the last war. The shaft is the second currently producing ore in the country. The Konrad Shaft went into operation a year ago. These two mines together fill Poland's copper ore requirements.

IN AUSTRALIA

A land survey for nickel is to be made this year in northwestern areas of South Australia and adjacent areas of Western Australia and Northern Australia.

The survey is to be made by Geosurveys of Australia. It is to be one of the most comprehensive surveys of its kind ever undertaken in Australia. R. T. Sprigg, Geosurvey's managing director, has been reported as saying that the areas to be surveyed harbor some of the greatest nickel deposits in the world.

G. R. Fisher, Chairman of Mount Isa Mines Ltd., announced that diamond drilling has indicated that substantial additional copper reserves exist at Mount Isa. Confirmation by further exploration work was necessary before the ore could be included in published reserves, which now total 3.7-million tons.

He said that further extensions to the large low-grade silver-lead-zinc ore body at the north end of Black Star section were disclosed and substantial tonnages indicated. Further drilling was in progress.

A report from Sydney states that New Caledonia is developing its iron ore resources as a major export to Australia. New Caledonia reportedly hopes to produce 180,000 tons of ore in each of the next two years, thereafter increasing output to 200,000 tons annually. Mines were described as largely mechanized. The ore reportedly will be used in Australia by the Broken Hill Pty. Co. for making steel.

IN THE NEAR EAST

TURKEY

Only 80,000 tons of chrome ore were exported through the port of Izmir in 1954, compared with 260,000 in 1953, it was reported. Exporters are said to be negotiating with the Turkish government for a reduction in the export tax to 1% from the present 5% in hopes of stimulating chrome ore exports.

Reserves of wolfram estimated at 5-million tons have been discovered near Uludag, Turkey's Mount Olympus in the northwestern section of the country.

Prof. H. N. Pamir, director-general, Institute for Mineral Research & Exploration, disclosed that prospecting had been carried out since a piece of the tungsten ore was found by a shepherd boy 4 yr ago.

According to Prof. Pamir, the deposit appears to descend to about 750 ft. He added that laboratory tests show a 5%-10% tungsten content.

Wolfram deposits discovered on the Ulu-Dag, near Brussa, will be worked by the Turkish Eti Bank, it was reported in Istanbul. The deposits are said to be rich.

An official of the Turkish Prospecting Office said that ore content averages about 0.5%.

IN THE PHILIPPINES

Discovery of uranium on the property of the Philippine Iron Mines was made by George T. Scholey, consulting engineer for A. Soriano & Co., and John E. Frost, chief geologist, while they were making a radiometric survey of the area. Confirmation was made by engineers of the Philippine Bureau of Mines. All radioactive spots show some copper and molybdenum.

Seven of the primary ball mills and classifiers are ready for operation at the Toledo Copper mill. Installation of the four 14 ft x 18 ft Oliver filters and auxiliary equipment is about completed. The thickeners and flotation machines were expected to be ready by the end of December. Completion of the mill has

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Plant shown is Jessie H. Mining Co., Grand Rapids, Minn., employing an Eagle Water Scalping Tank, an Eagle 24" x 25' fine material double screw unit, and an Eagle 7' x 30' log washer for Fe ore washing . . . 200 t.p.h. feed, 70% recovery.

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Philippines *(Continued)*

been held up by delayed shipment from Japan of the conveyor belt equipment.

In October, ore reserves were recalculated and showed positive ore, totaling 25,200,000 tons of 1.08% copper and probable ore of 9,700,000 tons of 0.95% copper, or a total of 34,900,000 tons, averaging 1.04% copper. This increased tonnage has been blocked out by diamond drilling to the northwest of the main orebody. A large area remains to be drilled, with excellent possibilities, according to a geophysical survey.

Samar Mining Co. has been granted a loan of 1,800,000 pesos by the RFC for the company's Masara gold mine project in Davao, which has been under development for 8 yr.

Construction work on the mill has advanced on schedule and it is expected that milling operations will begin in May 1955. In addition to its gold content, the Masara ore contains minor amounts of by-product copper, lead and zinc, which will be recovered.

IN ASIA

CHINA

Another recent mining enterprise in Hong Kong is a kaolin mine at Ha Wan, also in the New Territories. This mine is still in the exploratory stage. About 100 tons have been mined for local consumption at HK$70 (US$12) per ton. Export price would be around £6½ per ton including cost for packing and incidental expenses.

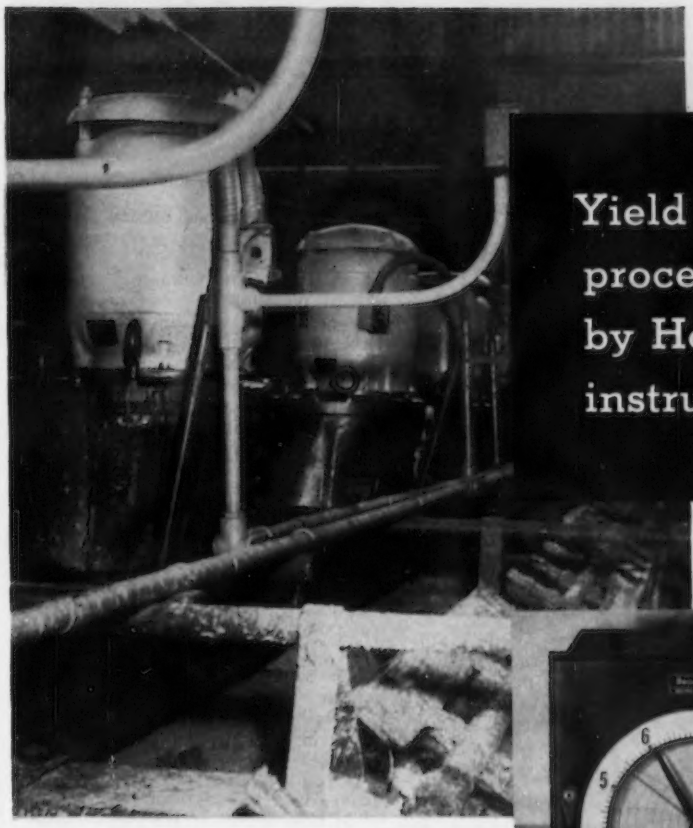
Iron ore mining at Ma On Shan, also in the New Territories, is now making good progress, thanks to Japanese investment and interest.

The ores, after processing by the new plant recently installed, are almost entirely shipped to Japan, where demand is urgent in view of recovering Japanese shipbuilding and other industries. Output has been increased and the quality has improved following the use of the new processing plant.

Wolfram also is found in the New Territories at Lien Fa Shan. About 65% is suitable for export. Right now there is, however, lack of demand from overseas for local wolfram. This is due to abundant supplies from Red China going to Russia which resells the ores to Western countries.

Japanese firms have reported offers from Communist China to sell iron ores mined in Hainan Island off South China and in Shangtung Province, North China.

A spokesman for Nichimen Jitsugyo Co. said Communist China had offered 20,000 tons of iron ore mined in Chinlingchen Mine, near, Tsingtao, Shangtung Province, for trial imports at $7.77 a metric ton, f.o.b. Freight cost to Japan was estimated at about $3 a ton. Iron content of the ore was said to be 57%.



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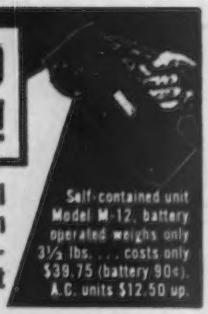

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.....

China *(Continued)*

Nissho Co. said that 50,000 tons of iron ore mined in Hainan Island was offered for trial imports at $8.93 a metric ton, f.o.b. Freight cost here was estimated at about $5.50 a ton. Iron content was said to run 58%.

INDIA

The third of three shipments of machinery for setting up a silver refinery in India arrived in New Dehli last month. Machinery was supplied by the German firm, Demag Electro Metallurgic.

RUSSIA

Soviet authorities have given gold mining a high priority and an intensive drive to build up Russia's gold reserves is underway.

F. J. Erroll, M.P., a member of the recent all-Party Parliamentary delegation from London to Russia, disclosed Russia's accelerated gold mining drive in an article in the December issue of *The Director*, journal of the Parliamentary Panel of the Institute of Directors.

Erroll also is a director of Ashtani Goldfields Corp. and other companies, so gold mining was a particular interest with him during his visit.

In *The Director*, Erroll discusses a gold mine he visited 10 mi north of Sverdlovsk in the Urals. He said the mine was a new venture. "The main shaft was sunk in about 1951 and about 1,000 tons of reef are hoisted every day from the main working level 350 ft below the surface.

"The winding equipment is up to date and the stations are just what one would expect in a modern mining undertaking," he added. Erroll said that he was told that in addition to the mine he visited, there were several smaller gold mines and also surface workings in the Sverdlovsk District.

Erroll alone among the Parliamentary delegation listed a gold mine among things he would like to see. Russian officials willingly granted his request.

IN AFRICA

For the first time since 1945 large mineral concessions are being granted by the Government of Mozambique. Axe Viking Lillas of Nassau British West Indies, have been granted two covering concessions some 25,000 sq km.

One in the Tete area is reported to be highly mineralized, occurrences of magnetite iron ore, copper, gold, titanium, corundum and columbite being stated to exist. The second one contains a promising tin-columbite formation. The concessionaires are slated to be investigating an iron-coal project, coupled with a study of the hydroelectric possibilities of the Pomfe and Revugue Rivers.

A new world record for underground tunneling was established at the Harmony Gold Mine in the Orange Free State during November and December when 1305 ft of straight development plus 87 ft of subsidiary work was accomplished in 26 continuous working days, beating the previous record held by the Durban Roodepoort Deep mine on the Witwatersrand.

An extensive diamond drilling program has been completed over a very considerable distance on ground lying to east of the Witwatersrand, where geophysical surveys indicated the possible existence of gold-bearing formations stretching some 80 mi.

Only two areas have been discovered which justify further exploratory work by underground development, while a third is being drilled further.

Underlying formation is the Kimberley Reef, which in addition to its gold content is the main uranium-bearing formation on the Far East Rand. The two areas that have yielded values could possibly support one new mine each.

Reports from Mauritania in French West Africa say that as a result of the workings of the copper pilot plant at Akjoujt, there will be an exportable surplus of 300,000 tons annually of 64% magnetic iron ore. The pilot plant is operated by the Societe des Mines de Cuivre de Mauritanie, which added that its research has uncovered "an important" deposit of 55% iron ore.

Initial development at Hartebeestfontein Gold Mining Co. in the Klerksdorp District has given excellent values. Of 1400 ft sampled, all proved payable averaging 53.43 dwt over a channel width of 13.7 in. equal to 732 in.-dwt. It is expected that production will start in April.

British Atomic Energy Authority has agreed to buy uranium from the Rhokana Corporation of Northern Rhodesia. Arrangements are being made to mine uranium ore and treat it in a plant to be erected for this purpose. It was pointed out, however, that the deposit is small and the profits will be insignificant compared to the corporation's total profits.

As a result of expansion plans now nearly completed, Rustenburg Platinum Mines is now the largest single producer of the metal in the world.

Work that remains to be done is the bringing into commission of two vertical shafts and modifications of the reduction of plant. The matte treatment plant has now been brought into operation and as a result quantities of nickel and copper are being recovered.

Installation of a supersize axial flow mine ventilating fan has been started at Mufulira in Northern Rhodesia. It is designed to exhaust 1-million cfm, but variable pitch blading will give it flexibility to meet the needs of the property. Diameter of the fan rotor is 214 in. which is mounted direct on the shaft of a vertical electric motor of 1,150 bhp. Overall height of the fan is 55 ft. Total weight is 80 tons.

With Armco Dredge Pipe it's easy to...

Get the size and lengths you need

Wide range of diameters from 6 to 36 inches—wall thicknesses from ¼- to ½-inch. And you can specify exact lengths as your job requires.

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Machine-reduced or -expanded ends in diameters from 6 to 28 inches make it easy to get tight joints with standard Armco Shore Pipe. Individual lengths can be disconnected and moved easily and quickly. Pipe ends are also supplied flanged for use with ball joints, and with half-oval bands for use with rubber sleeves for pontoon pipe. Special end preparation available as required.

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Write for complete information on Armco Special Analysis Dredge Pipe and its other money-saving uses in river and harbor work, hydraulic mining, and sand and gravel operations. Armco is ready to supply you with helpful, authoritative data, backed by almost 40 years' experience with dredge pipe requirements. Armco Drainage & Metal Products, Inc., Welded Pipe Sales Division, 4504 Curtis Street, Middletown, Ohio. Subsidiary of Armco Steel Corporation. In Canada: write Guelph, Ontario. Export: The Armco International Corporation.

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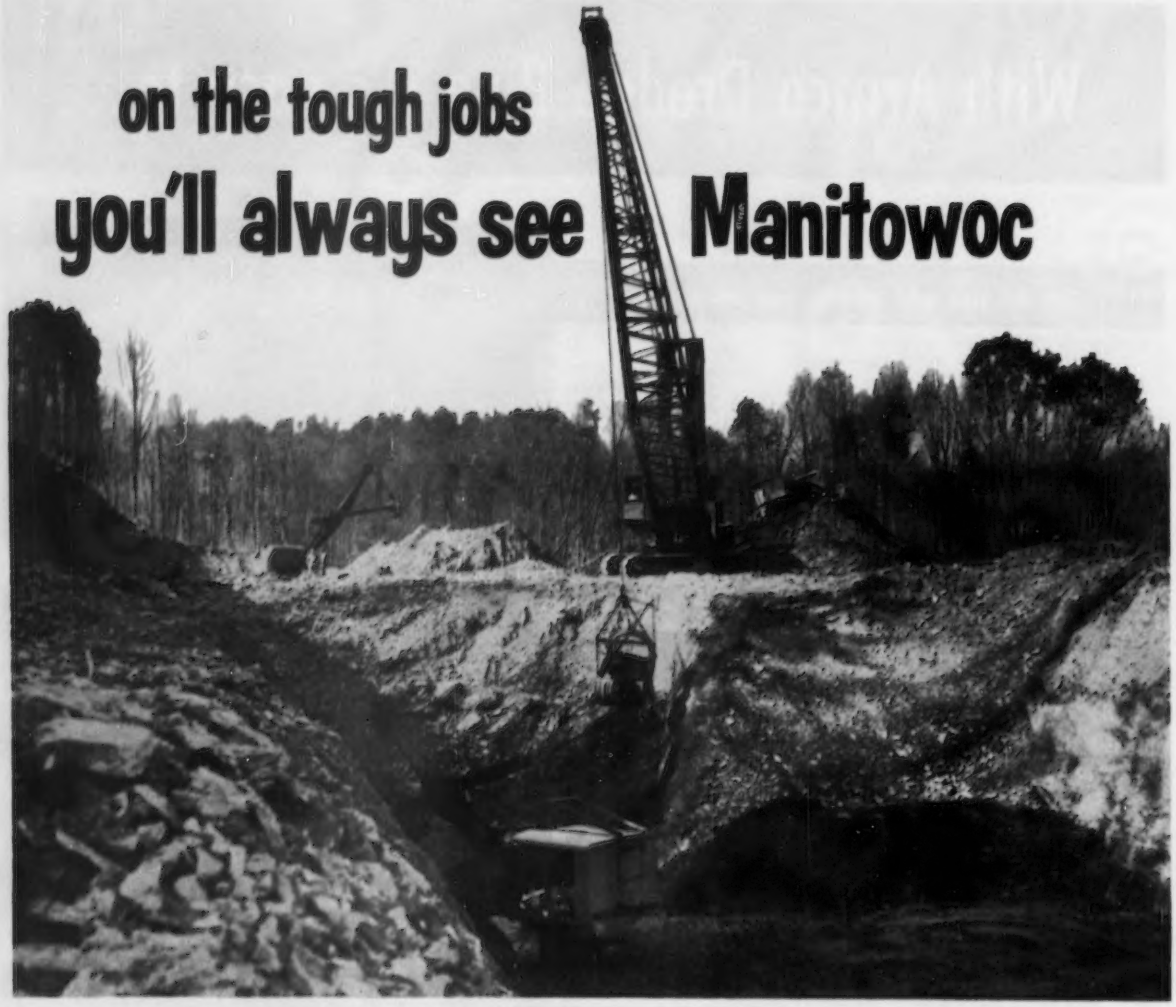

Manitowocs are a big producing team for Benjamin Coal Company, Ansonville Pa.

When the going is rough and rugged — you'll always find Manitowocs on hand to do the job. Profitable performance on tough operations is a Manitowoc specialty.

Here are 3 Manitowocs "putting out" for Benjamin Coal Company near Ansonville, Pa. — a Model 4500 dragline with 6 yard bucket and 120' boom strips from topside — in the pit a versatile 1¼ yard Model 2000 shovel covers a lot of ground, loading, cleaning and preparing — and in the background, a Model 3500 Hi-Lift shovel strips overburden at a record rate.

Look into Manitowoc's superiority — check such outstanding features as: faster working cycles, faster travel speeds, long reaching booms, top stability and simple but sturdy design and construction.

These are just some of the reasons why you see more and more Manitowocs on more and more stripping and mining operations. Send for details. Manitowoc Engineering Corp., Manitowoc, Wis.

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Speed Crane

CRANES 18-100 TON

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FIND URANIUM 100 TIMES EASIER

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MODEL 111B $495.00
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Cross section at left shows how KLEENSLOT Screens operate on a non-clogging principle.

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SEND FOR OUR ILLUSTRATED LITERATURE

Africa *(Continued)*

South Africa finished 1954 with an increase of some $85-million in her gold and foreign exchange reserves.

This was due largely to increased gold production and revenue from uranium recovery. Estimated earnings from this will be around $490-million—an increase of $62-million over that of 1953. Uranium contributed more than $34-million to the total and far more is expected during the current year. This improvement coupled with higher outputs from the new gold mines is expected to bring the value of the combined output this year to well over $560-million.

Intensive investigations are being made into the uranium-bearing possibility of the Dominion Reef series in the area to the west of Klerksdorp which is the western limit of major gold-bearing reefs in the Transvaal.

This series has a very low gold content.

Aluminum Company of South Africa, a subsidiary of Aluminium Limited of Canada, is to spend more than $700,000 on an extension to its Pietermaritzburg, Natal, factory during 1955.

When this is completed the total investment in ACOSA will exceed $4.25-million. The factory is the only one of its kind in Africa and was set up in 1948. Most raw material is imported from Canada.

Boreholes put down on the Girila Bomwe north orebody on the Bancroft Copper Mine in Northern Rhodesia from 1076 ft to 1094 ft gave the high average assay value of 4.91% total copper over a true width of 16.2 ft. 0.2% of the assay was in oxide form and .04% was cobalt.

Rhodesian Anglo-American Corp. has lent the Rhodesia Railway £1-million to buy 500 railway trucks. The trucks will be used to carry coal to the copper mines in Northern Rhodesia and also to carry general goods throughout the Federation of the two Rhodesias and Nyasaland.

Luipaardsvlei Estate Gold Mining Co. is to start production at its uranium plant on January 14, it was officially announced.

Formation of a new company, "Alucam" (Compagnie Camerounaise de l'Aluminium Pechiney-Ugine), to produce aluminum in the French Cameroons was announced on Dec. 28. The new firm is 80% owned by Pechiney and Ugine, France's two leading aluminum producers. Remaining 20% of the capital is held by the "Caisse Centrale de la France d'Outre-Mer," a government-owned financial institution for French territorial development, and the government of the Territory of the Cameroons. The initial capital is the equivalent of $8.6-million, and will later be increased to $28.5-million.

Shah Vershi Devshi & Co., Thika, has brought a new flake graphite mine into production with an estimated output of 50 tons per month.

CUT HANDLING COSTS WITH...

C&D *Slyver-Clad* Batteries

Per-ton hauling costs are substantially reduced, when C & D *Slyver-Clad* Batteries supply the muscle. Reason: exclusive C & D Five-Fold plate insulation. *Sedimentation* is virtually eliminated —leaving extra space for longer, heavier plates. Yet there's no increase in over-all battery size!

Get *more* work for *less* cost. Specify C & D—and see!

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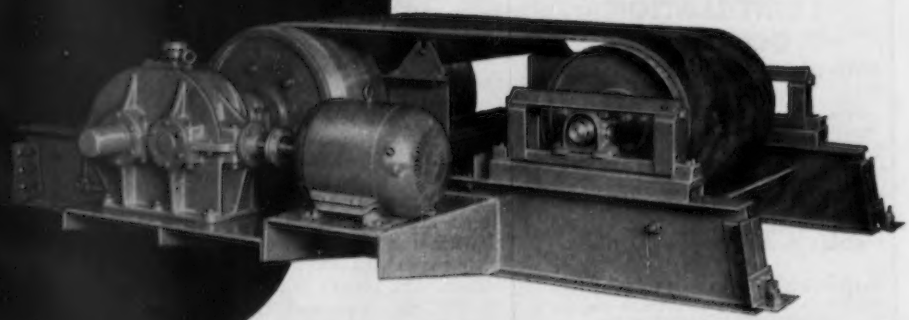
HIGH CAPACITY COBBING CONVEYOR

With automatic magnetic separation



Purification and concentration of metallic ores or non-metallic minerals is being accomplished successfully in many plants of large producers, with Homer Unit Type Magnetic Cobbing Conveyors. Large capacities, as in the operation illustrated at right, are handled at peak production levels—because the Homer Hercules Magnetic Pulley in the unit is *Permanently* magnetized. Down-time and production losses caused by loss of magnetism are eliminated.

If you have a magnetic separation problem in your plant—it will pay you to investigate Homer Permanent Magnetic Equipment. Write or phone—a competent representative is at your service.

Photo above shows a 30" x 42" Homer Magnetic Unit Type conveyor cobbing a mixture of iron ore and rock. This unit is handling 110 net tons/hr., at a belt speed of 300 ft./min. Iron ore content is approximately 40%, with rock sizes from 3" to 6" down to fines.

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. . . the FINEST in Permanent Magnetic Equipment for Industry

COST-CUTTING MEMOS:

SPOT THE DRILL HOLES RIGHT: Drilling, drill patterns, and spacing are vital factors in reducing explosives costs. In hand-steel days, each hard-won hole was carefully planned to gain maximum breakage and to pull the entire length. Today, careful supervision should be employed to avoid bootlegs and poor fragmentation which result from hasty, unplanned drilling.

USE THE RIGHT SIZE CARTRIDGE: It's costly to tie up manpower arguing with stuck cartridges. Be sure you are getting the proper diameter for easy loading. In small diameter holes, take bit wear into consideration in ordering your explosives, reducing diameter of cartridge accordingly. Redi-Slit® cartridges can give both compaction and trouble-free loading.

USE ENOUGH STEMMING: Large diameter holes take a lot of explosives—too much for you to write off the waste of energy which results from "blown-out" shots due to insufficient stemming. Initiation with electric blasting caps at the point of maximum confinement also helps to put the explosives gases to full and profitable use in both large and small diameter holes.

COMPARE MILLISECOND DELAY RESULTS: Organized tests can show what may be achieved with millisecond delay shooting and which pattern gives best results. Check benefits not only in stoping, but also in drifts, raises and sinking shafts. Open pit operations should compare progressive and alternate patterns. Sequence photos can show rock movement.

BETTER BLASTING is a combination of the right explosives plus the right methods. The economy and flexibility of fixed explosives in blasting operations have been firmly established. Here are a few of the many ways you can cut costs even further in both open pit and underground work . . . and aid the productivity of your loading crews. If your blasting methods haven't been checked lately, why not call your nearby Atlas representative? His suggestions may help you cut costs—and increase production, too. And write us if you'd like to receive the free, informative periodical "Better Blasting," published quarterly by Atlas to bring you technical tips and product announcements.

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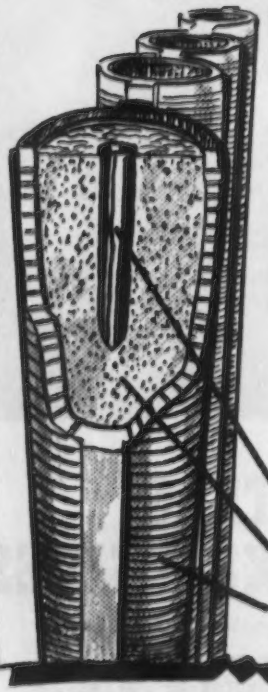
THE CIRCLE WORKS FOR YOU INSIDE AN EXIDE-IRONCLAD



SLOTTED TUBES INSIDE AN IRONCLAD KEEP ACTIVE MATERIAL IN FIRM CONTACT WITH CONDUCTING GRIDS OF THE POSITIVE PLATE... THIS GRID PROTECTION LENGTHENS LIFE OF BATTERY. THE SLOTTED TUBES EXPOSE MORE ACTIVE MATERIAL TO THE ELECTROLYTE... FOR GREATER POWER. FINE TUBE SLOTS HOLD MATERIAL IN CONTACT WITH GRID LONGER... RESULT, THE IRONCLAD'S ABILITY TO DO YOUR MINE HAULAGE JOB FOR A LONGER PERIOD OF TIME. THAT IS WHY

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Exide INDUSTRIAL DIVISION, The Electric Storage Battery Company, Philadelphia 2, Pa.

GM DIESEL
CASE HISTORY NO. 5310-1X

OWNER: American Zinc Company, North Friends Station Mine, Mascot, Tenn.

INSTALLATION: GM 4-71 Diesels powering 3 Koehring Dumptors. Units haul 8¼ tons of rock and ore on 1100-foot run up 11½% grade to surface.

PERFORMANCE: GM Diesel-powered units help 20-man crew produce 500 tons of ore per day. Use of rubber-tired equipment cut cost of access shaft construction by 70%.

It Pays to STANDARDIZE on

GM
GENERAL MOTORS
DIESEL POWER

GM DIESELS GO UNDERGROUND

to make trackless mining pay

One of the world's most efficient small underground mines, the American Zinc Company's new North Friends Station mine is proving the economy of trackless operation. With a fleet of three GM Diesel-powered Koehring Dumptors handling the haulage, the mine is producing 500 tons of ore per day—about 25 tons of ore per man-shift. Mine Foreman Bill Armstrong says: "These units run along month after month with almost no repairs. Our costs are much less than we expected."

General Motors 2-cycle Diesels are just as much at home underground as on the surface. Two-cycle operation with uniflow blower scavenging gives more complete combustion of low-cost fuel for higher efficiency and cleaner exhaust. Used with exhaust scrubbers and adequate ventilation, mine air stays well within permissable limits. And two-cycle operation means faster acceleration, quicker response to controls, faster haul cycles for increased production.

There's a GM Diesel for every kind of mining job. Specify GM Diesel power in *your* equipment. It will save you money.

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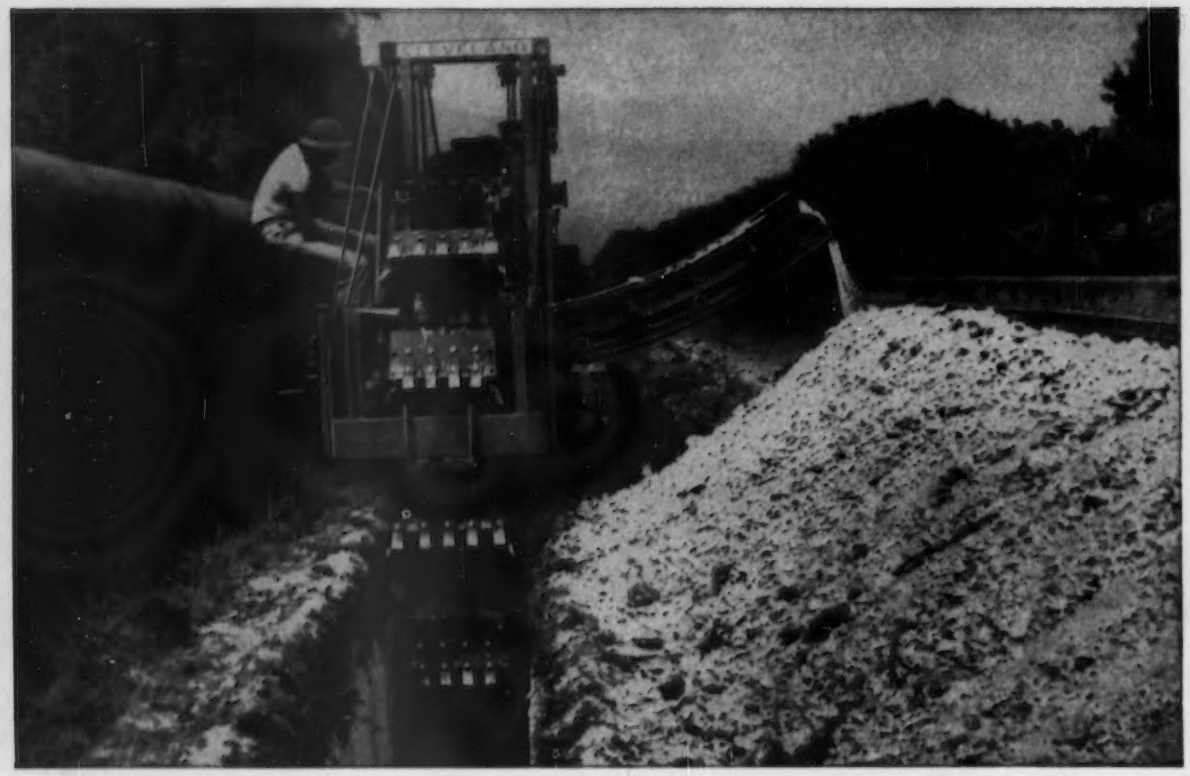

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Trencher teeth stay sharper 2 to 3 times longer when hard-faced with HAYSTELLITE tungsten carbide rod. The hard-facing material protects the teeth from severe abrasion as they tear through rock, sand, shale, and clay at high speeds. HAYSTELLITE tungsten carbide has good shock resistance, too, and won't chip off under sudden impact.

On this job, the teeth were made of a tough vanadium steel and faced with a thin layer of HAYSTELLITE tube rod. The combination of a tough base metal and an extremely hard, wear-resistant surface helped to double the continuous service life of the trencher. Other earth-moving equipment subjected to abrasion and impact can be protected in the same way. Bull-dozer blades, dipper teeth, post-hole diggers, road disks and plows, will all operate for long periods of time, at low maintenance cost, when hard-faced with HAYSTELLITE tube rod.

Your local dealer carries a complete line of HAYNES hard-facing alloys. He will be glad to recommend a HAYNES rod especially designed to resist abrasion, corrosion, impact, erosion or heat. Ask him for descriptive literature. If you don't know the location of your local dealer, write to Haynes Stellite Company, a Division of Union Carbide and Carbon Corporation, Kokomo, Indiana, for full details.

See... | **Your local Haynes Stellite Dealer**

— or —

Write... | **to Haynes Stellite Company**

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*Note extremely rugged conditions in this photo, showing bottom loading conveyor system in British coal mine. Inset shows roll of SCANDURA.

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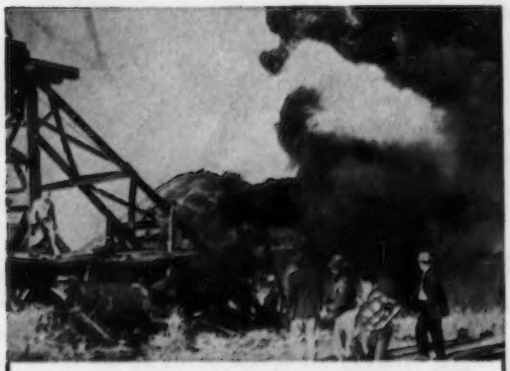
NEW **SCANDURA**

The original P. V. C. coated conveyor **BELTING**

You want *extraordinary resistance* to wear and tear with top tonnage hauls—and you get it with SCANDURA. But even more, you want *fireproof conveyor belting* that eliminates one of the great hazards of mining—fire caused by friction when your conveyor belt slips or stalls.



LET'S LOOK AT THE RECORD!

About 12% of coal mining fires in the past several years have been attributed to conveyor-belt friction.

At the 1953 annual meeting of the Illinois Mining Institute, data was presented to show that the majority of belt fires result from stalled belts while the driving pulley continues pulling.

In the tragic Evanston, Ky. fire in which 4 men lost their lives, fire was reported to have had its origin in the friction caused when a fall stopped the belt, while the drive motor continued to operate.

This record clearly points to the great need for SCANDURA BELTING!

SCANDURA, developed by our parent company, and now being manufactured in our Charlotte, N. C. plant, has these unique features:

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- *Works in temperatures ranging from 22° below to 212° above.*
- *Can be made in widths from 1" to 42" and thicknesses from ⅛" to ⅜".*

SCANDURA has been tested and used with gratifying results in Britain since 1946. For safety and economy, it's in a class by itself. Write, wire or telephone for complete data.

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The ideal bit for feed leg drilling

LIDDICOAT

USED-TO-DESTRUCTION
No Resharpening

LIDDICOAT BITS and feed leg drilling machines . . . you just can't beat this speedy, cost cutting combination! Designed for efficient, low cost operation, Liddicoat is the bit that is used-to-destruction and then discarded . . . no resharpening . . . no delays . . . no extra costs . . . the ideal bit for easier drilling with feed leg machines.

LIDDICOAT TEE CEE is a tungsten carbide insert bit designed for on-the-job interchange with Liddicoat used-to-destruction bit . . . both fit the same drill steel. Now, you can switch to the most economical bit—right on the job—on the same steel—to meet varying ground requirements. No delay whatever!

NO THREAD SOCKET . . . The socket of the Liddicoat Bit is accurate to thousandths of an inch . . . precision that means a stronger connection and longer bit life. Of prime importance is the strong attachment without threads. Forged between the socket of the bit are the flats between the rounds. Any turning of the rod within the socket tends to lock the bit tightly to the rod, yet is easily removed with a weighted knockoff block. For full details, call on us or write.

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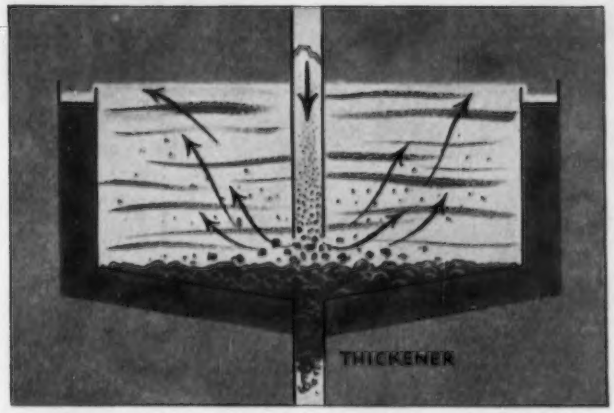
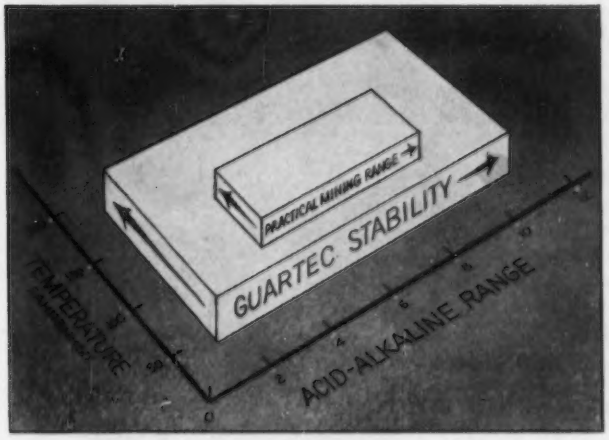
Now—Faster Settling in the Thickener with GUARTEC



Faster Settling in the thickener is one of the big advantages that Guartec can offer your refining operations. Guartec, with 5 to 8 times the settling action of starch, quickly agglomerates fine particles and settles them to the bottom, as shown above. There they form a loose mass that can be drawn off easily without blocking the outlet.



Wide Stability is a strong feature of Guartec for mineral operations. As the graph above shows, Guartec operates effectively in a pH range of 1.2 to 11 and flocculates at temperatures of 40 to 180° F. It is available in commercial quantities packed in 100 pound bags lined with moisture-protective pliofilm.

New Vegetable Gum Colloid Available in Commercial Lots

General Mills' new Guartec—a natural gum colloid of the guar seed settles ore and other solid particles faster and more uniformly than most flocculants. Many operators find that Guartec:

1. **Improves mineral recovery**
2. **Cuts settling time**
3. **Speeds tonnage production rate**
4. **Permits greater production with same equipment**
5. **Cuts the frequency of plant "down" time**
6. **Features wide stability**
7. **Is effective under varied conditions**

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Guartec is used in thickeners to "floc" slimes from uranium, zinc, iron ore, and manganese. It can clarify brines in potash refining, conserve water for re-use in iron ore processing, and perform many other flocculating jobs.

GUARTEC AMOUNTS

Mere "trace" amounts of Guartec will help you solve your settling problems. As little as 0.1 pound of Guartec (about 3¢) per 1,000 gallons of slime speeds settling in thickener or tailings pond. You get more tons of refined ore, faster, with the same equipment . . . and with no danger of losing fine ore values to thickener overflow.

Besides its settling action, Guartec also works well as a flocculant for filtering, and as a blinding agent to save on expensive collectors in froth flotation.

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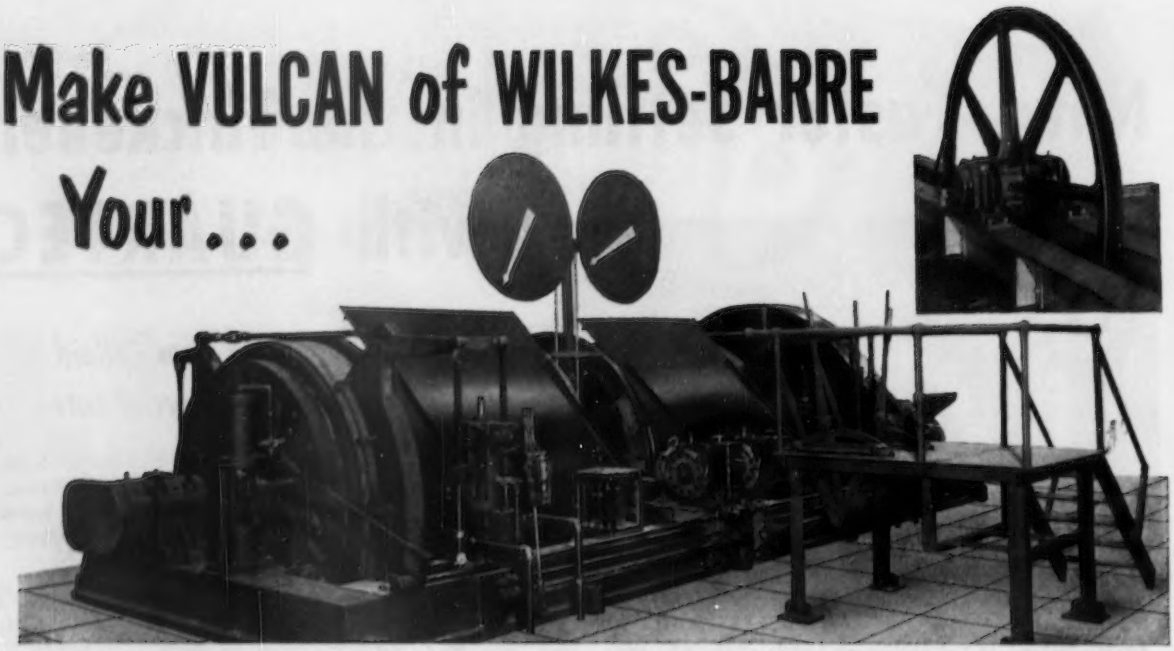

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In that time, Vulcan of Wilkes-Barre has designed and built electric hoists, sheaves, cages and skips in a wide range of types and sizes to meet all requirements.

Throughout the many years of development and improvement, full advantage has been taken at all times of every proven advance in design, materials and accessory equipment . . . so that today, Vulcan of Wilkes-Barre electric hoists, sheaves, cages and skips are unsurpassed for speed, safety, durability and operating economy. New designs are constantly being developed to meet all operating conditions. Why not write today for Bulletin A-396 (sheaves), A-407 (hoists), A-457 (cages and skips). Our experienced engineering department will welcome every opportunity to make money saving suggestions to you and your company.

Any information on items listed below will be sent to you immediately:

Rotary Kilns, Coolers and Dryers
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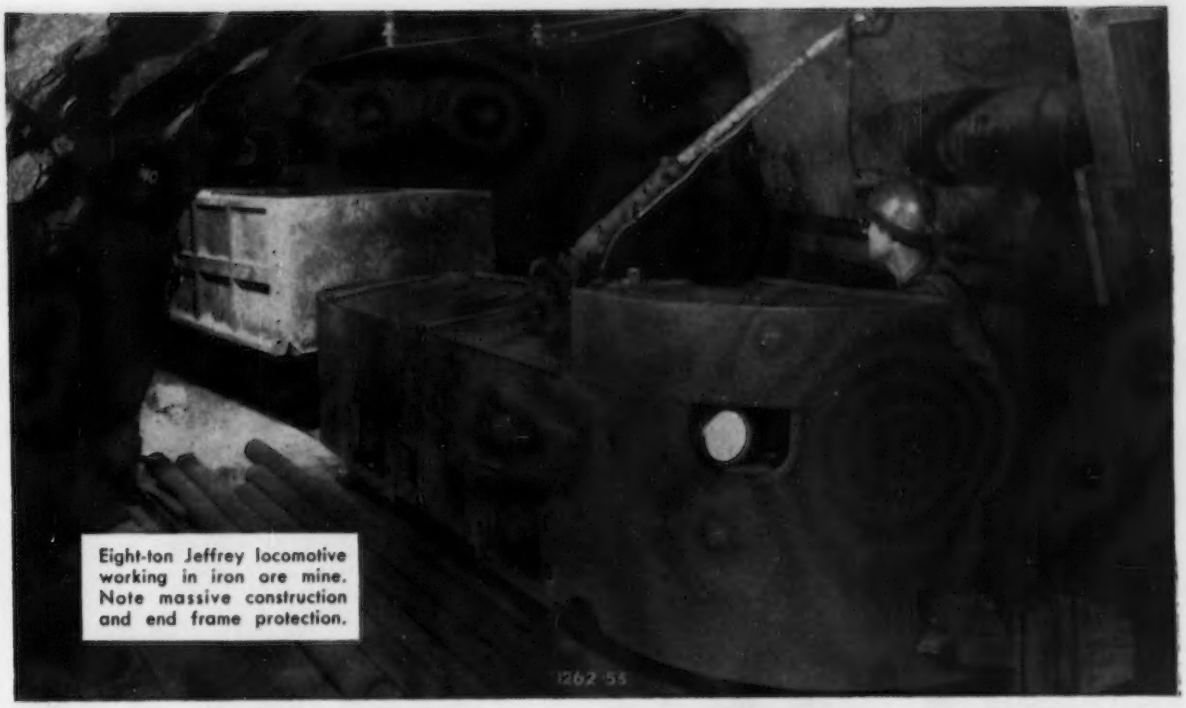
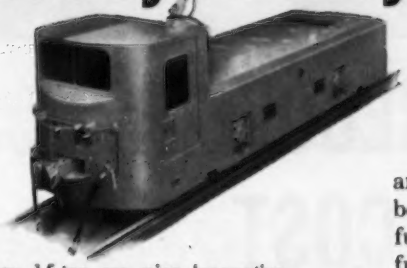


Eight-ton Jeffrey locomotive working in iron ore mine. Note massive construction and end frame protection.

Jeffrey Trolley Locomotives improve metal mine haulage



Jeffrey 15-ton ore mine locomotive. Enclosed cab offers weather protection for motorman on outside portion of haul and protection from roof falls on inside.

Six-ton Jeffrey ore mine locomotive. Rounded, welded end frames and smooth side frames with no projecting parts are desirable safety features.

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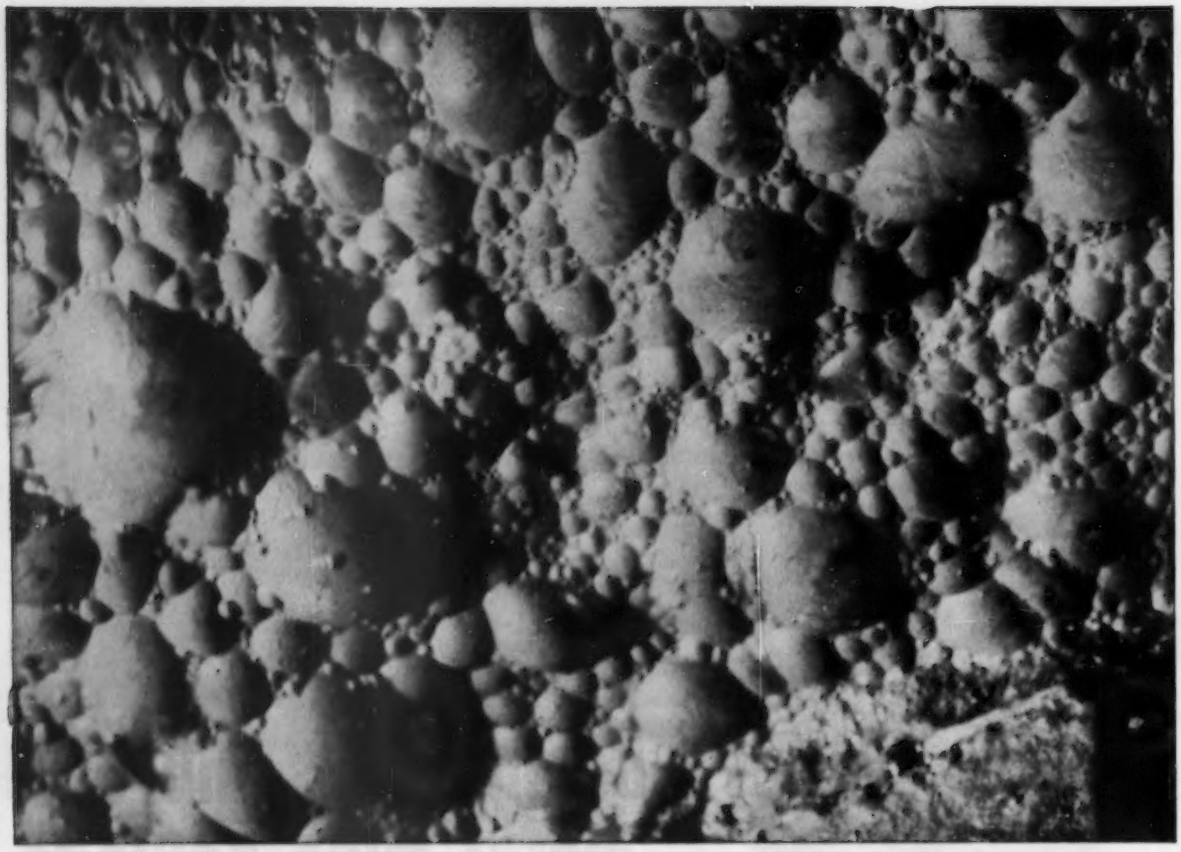

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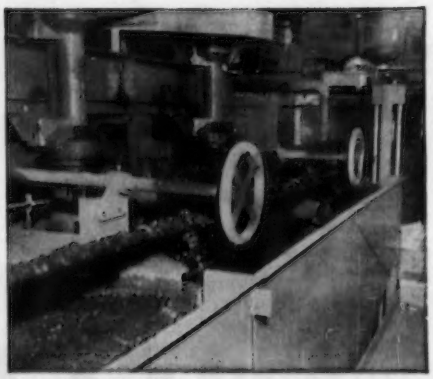

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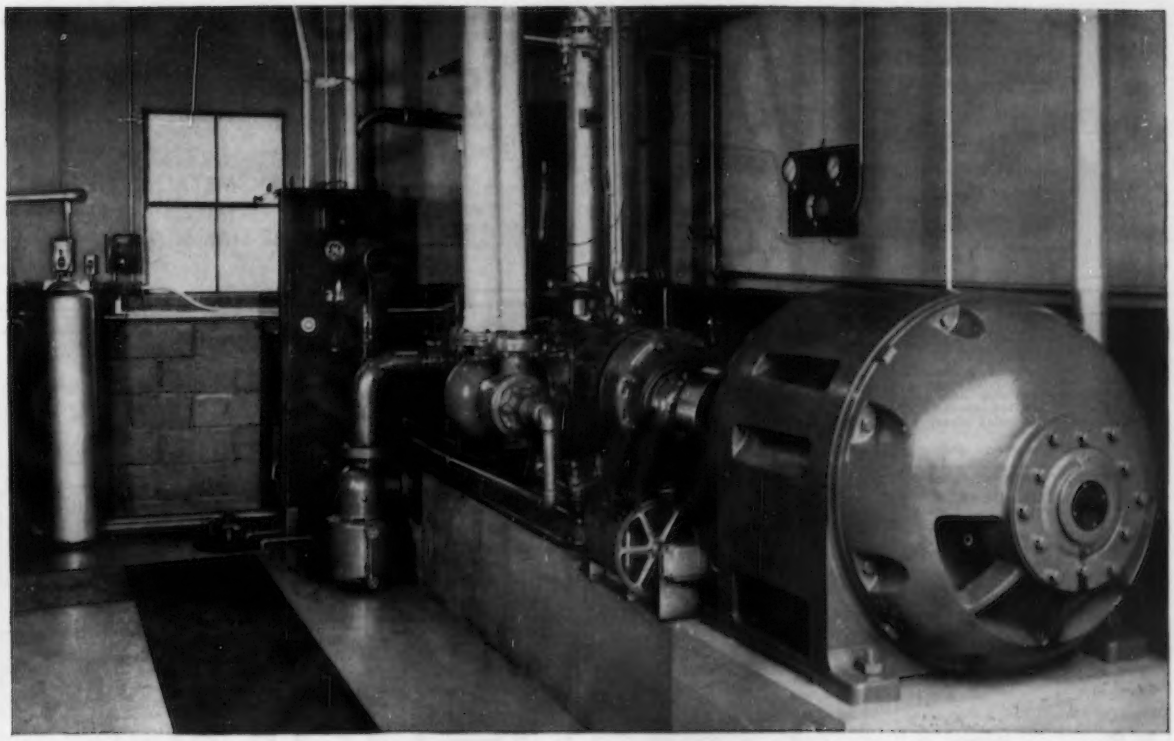

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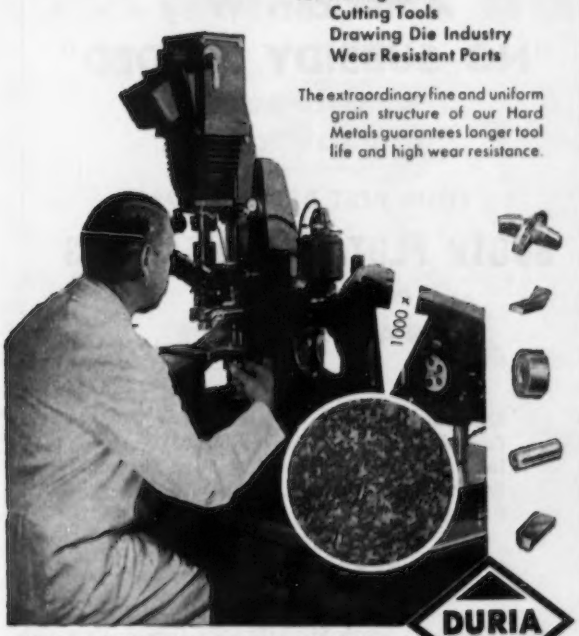

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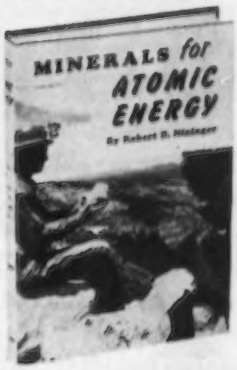

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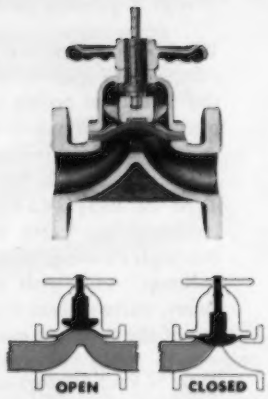

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When you decide to "roll on rubber" consider the reasons a Lorain Moto-Crane is your most profitable investment. You get a rubber-tire crane with more years of experience behind it, built by the originator of the truck-crane idea. You get a Thew designed and built rubber-tire carrier that is engineered specifically to withstand the "live loads" created by shovel-crane use. You select from the most complete line of rubber-tire shovel-cranes—capacities from 6 to 45 tons, plus many choices in power drives, engines and boom attachments.

This Anaconda operation is another example of the way Lorain completely serves the needs of mines, large or small. Anaconda's use of Moto-Cranes may well point out how you can put rubber-tire mobility to work at *your* plant.

Your Thew-Lorain Distributor is most anxious to help you with facts and figures. Call him soon!

A 3/4-yd. Moto-Shovel loading materials.

Construction of new facilities, another Moto-Crane job.

Here are three scenes at the big Anaconda Copper Mining Co. operations at Butte, Montana. In each picture, a rubber-tire Lorain Moto-Crane is shown performing a different kind of operation, from material handling to plant construction. Proof that Anaconda finds these versatile Moto-Cranes profitable is backed up by their purchase of 5 such machines to date.

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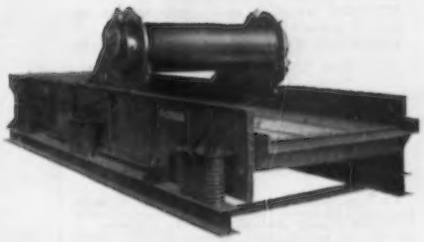
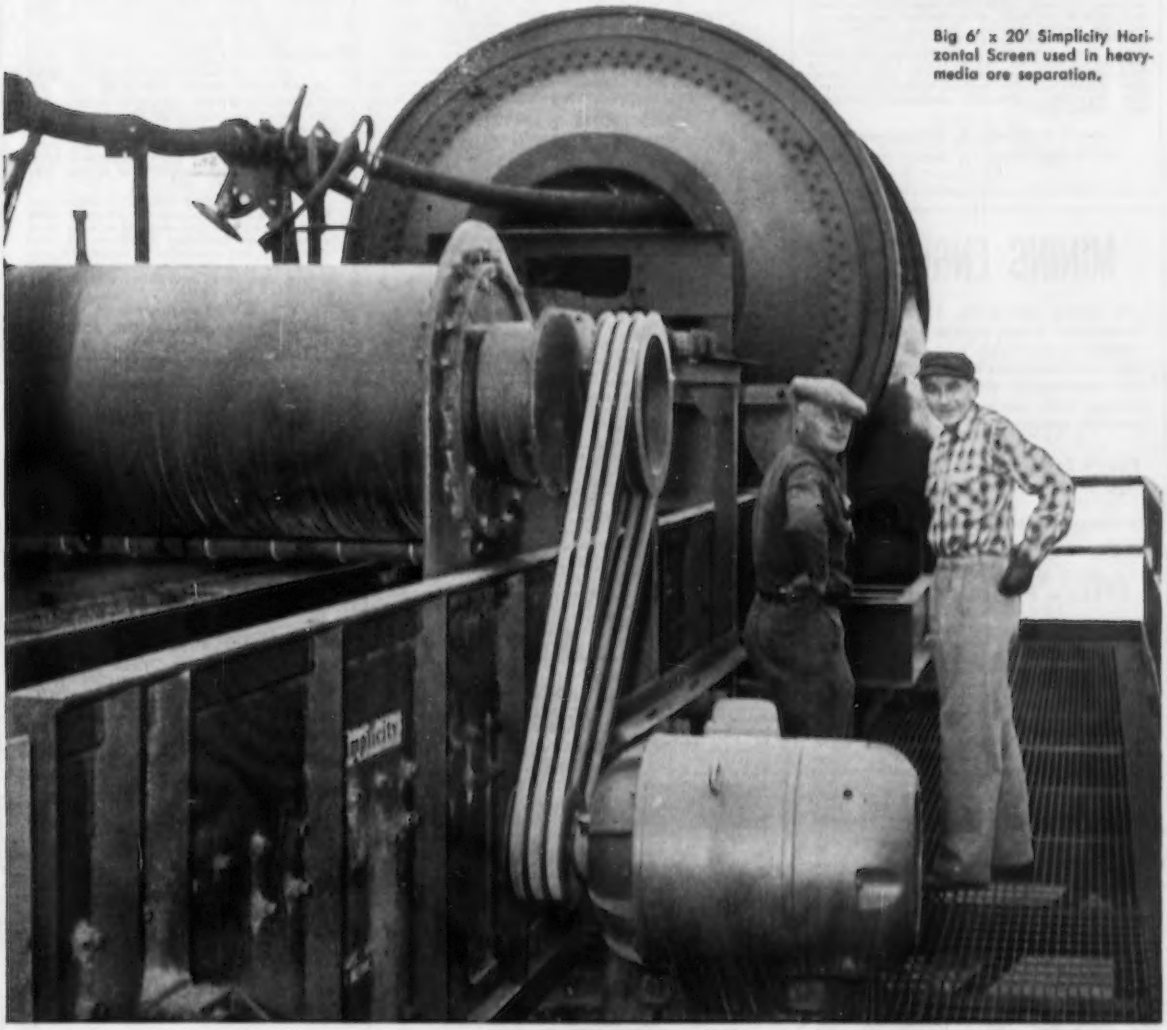
One of a series of advertisements prepared by THE ASSOCIATED BUSINESS PUBLICATIONS

Simplicity screens perform efficiently in heavy-media ore separation plants

Simplicity Horizontal Screens, built to perform efficiently even when headroom is at a minimum are in dependable daily operation in all phases of the mining industry. The Simplicity 6′ x 20′ Screen shown in operation in the photo is installed in a Michigan gravel plant for the production of improved gravel heavy-media separation. This is the same type of screen that has been used so successfully on the Minnesota iron ranges for dewatering and "sink-float" ore separation operations. This 6′ x 20′ unit, incidentally, is the largest of its type ever built. It's rugged and dependable and easily maintained. Complete shaft assemblies can be changed in 30 minutes time. For complete information about these screens and other Simplicity equipment, call your nearest Simplicity sales engineer or write us in Durand.



Big 6′ x 20′ Simplicity Horizontal Screen used in heavy-media ore separation.



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Sales representatives in all parts of the U.S.A.

FOR CANADA: Simplicity Materials Handling Limited Guelph, Ontario

FOR EXPORT: Brown and Sites, 50 Church St., N. Y. 7, N. Y.

Simplicity
TRADE MARK REGISTERED

ENGINEERING COMPANY • DURAND, MICHIGAN

CLASSIFIED SEARCHLIGHT SECTION ADVERTISING

EMPLOYMENT • BUSINESS • OPPORTUNITIES • EQUIPMENT—USED or RESALE

UNDISPLAYED RATE

$1.50 a line. Minimum 3 lines. To figure advance payment count 5 average words as a line. (See ¶ on Box Numbers.)
POSITION WANTED undisplayed rate is one half of above rate, payable in advance.
PROPOSALS, $1.20 cents a line an insertion.

INFORMATION:

BOX NUMBERS count one additional line in undisplayed ads.
DISCOUNT OF 10% if full payment is made in advance for four consecutive insertions of undisplayed ads (not including proposals).
EQUIPMENT WANTED OR FOR SALE Advertisements acceptable only in Displayed Style.

DISPLAYED RATE

The advertising rate is $13.80 per inch for all advertising appearing on other than a contract basis. Contract rates quoted on request. AN ADVERTISING INCH is measured ⅞ inch vertically on one column, 3 columns—30 inches—to a page.

Send NEW ADVERTISEMENTS to N. Y. Office, 330 W. 42 St., N. Y. 36, N. Y. For March 8th Issue closing February 18th

MINE MECHANICAL SUPERVISOR

For long established American company in Mediterranean. Excellent living conditions and climate. Furnished housing provided. Must be competent supervisor in general mine mechanical work, blacksmithing, welding, upkeep of metal mining equipment such as air drills, steel treatment and sharpening, car loaders, haulage, hoisting, stushers, fans, pumps, diesel and storage battery locomotive tramming, diesel compressors, surface and underground electrical installations, saw mill, etc. Three-year contract. Schools to 14 years. Medical service. Salary open. Require with first reply complete record education, experience, references, photograph (optional), age, marital status.

P-4922 Engineering & Mining Journal
1111 Wilshire Blvd., Los Angeles 17, Calif.

MINING ENGINEER

Ore mining organization has opening for experienced mining engineer with extensive commercial experience. Must be qualified in the evaluation of ore mining properties. Salary commensurate with ability. Write fully setting forth previous employment, past earnings, references, etc.

P5079 Engineering & Mining Journal
330 W. 42 St., New York 36, N. Y.

ENGINEERS
SALES — PRODUCT DESIGN

Major heavy machinery manufacturer, located Midwest, has excellent opportunities for mechanical design engineers experienced in research and development and in new product design of machinery used in mining, crushing, cement and basic processing industries. Also sales engineers who have experience in this industry or in sales of heavy machinery. Exceptionally fine working conditions and opportunity for future. Write, stating education, experience, present employment, personal data and salary expected. Replies confidential.

P5088 Engineering & Mining Journal
520 N. Michigan Ave., Chicago 11, Ill.

ACME PERSONNEL SERVICE

"Famous For the Finest" in the Pacific Northwest . . . Now specializing in placement of technical mining personnel. One letter to this office will give you Nation-Wide recruitment in 54 cities . . . through the National Association of Personnel Consultants.

D. L. Reiff, Manager
721 W. Riverside, Spokane, Wash.

REPLIES (Box No.): Address to office nearest you
NEW YORK: 330 W. 42nd St. (36)
CHICAGO: 520 N. Michigan Ave. (11)
SAN FRANCISCO: 68 Post St. (4)

POSITION VACANT

MINE CAPTAIN required by large base metal operation in South West Africa. Successful applicant should be technical graduate and have had varied mining experience. Three-year contract. Transportation self and family, and salary while traveling. Climate and living conditions excellent. P-5176, Engineering & Mining Journal.

POSITIONS WANTED

MINING ENGINER, 25 years Successful and progressive Foreign and Domestic Mining Operations. Available as Manager or Superintendent. PW-1622, Engineering & Mining Journal.

METALLURGICAL ENGR., M.S. Mineral dressing, 10 yrs, engineering experience including 8 yrs. ore dressing research and development, 5 yrs. supervisory. Desires position of responsibility in operations or plant development. PW-5014, Engineering & Mining Journal.

GEOLOGICAL ENGINEER, B.S.—29, married, veteran. One year surveying, one summer field experience, speak Spanish. Prefer work outside U.S. Employed, available 30 days. PW-5172, Engineering & Mining Journal.

CHEMICAL-METALLURGICAL Engineer—B.S. Ch.E., 29, licensed engineer. 6 years experience extractive metallurgy, heavy inorganic and ore dressing fields. Design, development and production. PW-5282, Engineering & Mining Journal.

MILL SUPT.—Wide experience in sulphide and nonsulphide milling. Age 45. PW-5341, Engineering & Mining Journal.

METALLURGIST, DR. Sc., Comprehensive milling and laboratory experience. Competent in ore microscopy, spectroscopy, and x-ray diffraction. Desire responsible position for project development or laboratory research on ore-dressing problems. PW-5258, Engineering & Mining Journal.

MINING ENGINEER desires position with progressive company in supervision or mining engineering. Well rounded successful experience in metallic and non-metallic mines. (Mine superintendent, mining engineer, geology, labor negotiations.) Age 36, married, 3 children. Presently employed. Available reasonable notice. PW-5143, Engineering & Mining Journal.

SALESMAN, CRUSHING and Construction equipment, long experience. With construction crushing & mining equipment, wishes to make connections with good responsible company, with good first line equipment. PW-5119, Engineering & Mining Journal.

MASTER MECHANIC, with over 25-yrs experience in all kinds of construction equipment, as shop foreman, supervising mechanic, equipment superintendent, wants position with large company. Available Feb. 1st, '55. Job must be in supervision. PW-5120, Engineering & Mining Journal.

BUSINESS OPPORTUNITIES

900 acres proven manganese lands in heart of Batesville-Cushman quadrangle. Will sell; might lease. Write Bee Vanemburg, Owner, Batesville, Arkansas.

Lead, Zinc, Silver & Gold 2600 acres of rich ore substantial proven tonnage, several thousand assays, tunnels, shafts and maps. Location 6 miles from a hard road, in the Republic of Panama, no currency restrictions, exceptional tax deal, common labor top $3.00 per day. Will entertain capital assistance to produce ore, also sell part or whole deal. Write Point Realty Co., 1927 Ringling Blvd., Sarasota, Fla.

Mica Men Attention:— Deposit estimated 25 million tons mica schist containing 40% mica. Also about 50,000 tons lead zinc ore in place. For sale or lease. BO-5061, Engineering & Mining Journal.

METALLURGICAL EDITOR WANTED

An opportunity for interesting, varied, stimulating and useful employment is open to you on the editorial staff of Engineering And Mining Journal if you have these qualifications:

1. A degree in metallurgy from an accredited college or university based upon courses in ore dressing, smelting, and electro- and hydro-metallurgy.
2. Three to five years' experience in ore dressing and/or extractive metallurgy.
3. About 30 years old, preferably under 35, willing to live in New York area.
4. Ease in writing reports or articles, and the ability to express an idea clearly with drawings, photographs, or charts as well as in writing.
5. An alert mind that grasps new ideas quickly and occasionally gets a new idea on its own.

If you feel you have these qualifications, and if you'd like to consider editorial work in the metal and non-metallic mining field, please write, enclosing a resume of your experience and education, a sample of anything you have written, a recent photograph and an estimate of your salary requirements.

R. H. Ramsey, Editor
ENGINEERING and MINING JOURNAL
330 West 42 St., New York 36, N.Y.

WANTED
SECOND HAND
2000 CU. FT. COMPRESSOR

Ingersoll Rand XVHE-2 type two stage actual delivery 2000 cu. ft. per min. at 100 lbs. p.s.i. preferably 26" and 15½" x 13" stroke, 300 R.P.M. or very near.

Would consider damaged machine if necessary. No electrical gear.

W5112 Engineering & Mining Journal
330 W. 42 St., New York 36, N. Y.

WE WILL BUY YOUR SURPLUS PLANT OR EQUIPMENT

Specialists in liquidating mines, mills—industrial and construction plants.

W 5042 Engineering & Mining Journal
520 N. Michigan Ave., Chicago 11, Ill.

WANTED
USED GRATON-VANDERWILT POLISHING MACHINE

Specify Model and Year Purchased

W4661 Engineering & Mining Journal
330 West 42 St., New York 36, N. Y.

BUYER WITH CASH

Want industrial plants. Will arrange thru purchase of (1) capital stock, (2) Assets, (5) Machinery and equipment, whole or part. Personnel usually retained, strict confidence.

Box 1351
Church Street Station, New York 8, N. Y.

USED—REBUILT MACHINERY

BLOWERS
3—TM-8 Coppus Ventair, 15 HP
3—TM-6 Coppus Ventair, 5 HP
1—SM-425 Coppus Vano, 15 HP
1—SM-250 Coppus Vano, 1 HP
1—TM-5 Coppus Ventair, 2 HP
10—#2 Buffalo Mine Type, 3 HP
2—Joy Axivane 1-155 230 V DC

CAGES, VERTICAL
3—36" x 5', 40" between guides
1—30" x 46" floor—35" guides

CARDOX CHARGING PLANTS
1—Koreshell complete plant
1—Cardox complete plant with barrels

CARS
30—18 cu. ft., 18 gauge, RB, Card trucks, new bodies

CLASSIFIERS
1—8' x 26" Duplex Denver Rake
4—6' x 25' Dorr Duplex Rake
1—4½' x 16' Dorr Duplex Rake
1—24½ x 11' Akins Spiral

COMPRESSORS
1—I-R 990 CFM, 200 HP motor
2—I-R 284 CFM, 75 HP motors
2—445 CFM, D-13000 Cat Engines, skidded

BELT CONVEYORS
1—48" x 81' centers, steel frame, 10 HP
1—36" x 120' Jeffrey—steel bridge frame and catwalk
1—18" x 56' Pioneer, bridge frame

CRUSHERS
2—2' Symons Std. Cones, 30 HP motors
1—9 x 16 Rogers, late model, jaw
1—9 x 36 Cedar Rapids, jaw

LABORATORY EQUIPMENT
2—9½K McCool Pulverizers
1—9½K DFC Pulverizer
2—Braun Type UA Pulverizers
1—Wilfley Table #13-5, 24" x 50"
9—Analytical and button balances
1—4½" x 10" Davis Jaw Crusher

FLOTATION EQUIPMENT
2—6-cell #15 Denver Sub A
1—5-cell #9-S Fagergren, 36"

DIESEL GENERATOR SETS
1—300 KW, 480 V. G.M. Engine, air starting
1—250 KW, 480 V. G.M. Engine, air starting
2—112½ KVA, 480 V. Cat. D-17,000 engines
2—100 KW, 480 V. Cummins L.I. Engines

HOISTS, MINE SHAFT
1—250 HP 2-drum shaft hoist, Denver
1—200 HP, 1-drum Nordberg, complete
1—150 HP, 1-drum Ottumwa
3—125 HP, 1-drum, herringbone gears

HOISTS, TUGGER AND SLUSHER
3—I-R HNN1J 2-drum air
5—I-R 25 MNN3D, 3-drum electric
2—I-R 20 MN2D, 2-drum electric

BALL AND ROD MILLS
3—5 x 10 Allis Chalmers, Rod
1—5 x 10 Stearns Roger, Rod
2—6' x 22" Hardinge Conical, 50 HP
1—7' x 36" Hardinge, 100 HP
1—7' x 48" Hardinge, 150 HP motor
2—4 x 5 Eimco & C.I.W., 40 HP
1—5 x 6 Allis Chalmers

LOCOMOTIVES
7—Mancha Titan A & B, 18" or 24" gauge, 3½ ton capacity
1—G.E. 2½ ton, Battery, 18-24 gauge
1—Plymouth 10-ton diesel, late model, std. RR gauge

MUCKING MACHINES
5—Eimco 12-B, 18-24 ga. Rebuilt
1—GD-9 Gardner Denver, 18" ga. Rebuilt

TRANSFORMERS
2—250 KVA Allis Chalmers, 2400-480 V.
1—750 KVA Pittsburg, 44,000-2300 V.
1—1000 KVA G.E., 44,000-2300 V.

SPECIAL!!!
ROCK DRILLS AND PARTS
51—DA-35 Drifters & Power Feeds
19—FM-2 I-R Wagon Drills
$20,000 worth new DA35 & X-71 spare parts at discount.

MILLING MACHINERY IS OUR SPECIALTY

MACHINERY CENTER, INC.

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YOUR BEST SOURCE . . .
- for every industrial and power application
- odd lengths—long and short—reasonably priced
- One of the Largest Stocks in Midwest

Let us quote on requirements—send your inquiries

QUICK . . . from stock
We'll also buy your Surplus
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EAstgate 7-4777 Code: UNIWIRE

NO. 1 WEMCO 5/25 TPH CAP.
WKE HEAVY MEDIA SEPARATION
MOBIL-MILL WITH 5 FT. CONE SEPARATOR
54 ROTARY KILNS & DRYERS
4 x 42, 5 x 25, 4 x 20, 6 x 70, 7 x 110, 11 x 75, 8 x 125, 8 x 150, 10 x 125 & 10 x 160 SINGLE SHELL
5 x 35' RUGGLES COLES XB5—2 SHELL.
CRUSHING ROLLS
54 x 24, 42 x 16, 36 x 16, & 30 x 16.
48 BALL, ROD & TUBE MILLS
10'x48", 8'x48", 8'x22", 6'x22", 6'x36", 5'x36", 3'x7', 4'x5', 4'x7', 4'x14', 5'x10', 5'x14', 5'x18', 6'x7', 6'x8', 6'x9', 6'x10', 7'x5', 7'x6', 7'x7', 8'x12' & 8'x6'.

R. C. STANHOPE, INC.
60 E. 42nd St., N. Y. 17, N. Y.

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CALL
AMERICAN AIR of JERSEY
AIR FOR SALE OR RENT SINCE 1902
GAS • DIESEL • STEAM • ELECTRIC
NEW AND QUALITY REBUILTS

STATIONARY

48.8 CFM	3500 psi	3 stage Ingersoll Rand	25 HP
122 CFM	100 psi	7x7 Worthington HB	20 HP Elec
125 CFM	100 psi	6½ x 4½ Davey VB6	6 available
142 CFM	125 psi	6/6/5x5 Worth M-25	25 HP Elec
254 CFM	125 psi	10 x 10 Ingersoll ER-1	40 HP Elec
268 CFM	500 psi	10/4½x10 IR—75 HP	Synch.
270 CFM	125 psi	Joy WL-60	2 available
278 CFM	125 psi	2 Stage Chicago PB	50 HP Elec
285 CFM	125 psi	2 Stage Gardner "WB"	50 HP
289 CFM	100 psi	2 cylinder Davey	50 HP Elec
291 CFM	140 psi	3 cylinder Ingersoll Type 40	
294 CFM	125 psi	10 x 11 Chicago T-B	2 available
312 CFM	100 psi	4 cylinder Gardner "AAG"	60 HP
343 CFM	500 psi	11/5x13 Worthington HB2	Elec
364 CFM	120 psi	12 x 7 Gardner "RX"	2 Available
435 CFM	100 "Unitair"	Joy WL-40	75 HP Elec
552 CFM	125 15/8x16	Ingersoll 100 HP	Elec
560 CFM	125 psi	2 stage Chicago PBS	100 HP Elec
676 CFM	110 psi	15-9½x12 Ing. XRB	
931 CFM	35 psi	17 x 13 Chicago T-B	Steam or Elec
1065 CFM	35 psi	20x12 Penn 3-A	100 HP Elec
1374 CFM	100 psi	22/14x10 IR PRE-2	3 available
1570 CFM	50 psi	15/13 x 14 Penn DB-1	200 HP
1723 CFM	110 psi	"XPV" 4 corner Ingersoll	Steam

SPECIAL—Compressors for special air applications and conditions
PORTABLE—15 CFM to 600 CFM
VACUUM PUMPS—3 CFM to 5881 CFM
DELIVERIES—Always prompt.

American
AIR-COMPRESSOR CORP
47th ST & BELL AVE NORTH BERGEN N J
Telephone UNion 5-4848

Yuba 6' electric gold placer dredge.
Bucyrus 20" hydraulic dredge, 115' cut, elec.
Rotary dryers, kilns, 8x125, 7x125 6x110 (2).
Diesel-electric generators, 320 to 1000 KW.
Power shovels, draglines, 2 to 14 yds.
Rock, ore crushers, jaw, gyratory, large.
Euclid diesel dump trucks; 15-22 tons.
Locomotives, 10 to 100 tons, std. & 36" ga.

H. Y. SMITH CO.
828 N. Broadway Milwaukee 2, Wis.

A.G.
DIESEL ENGINES • GENERATOR SETS
10 TO 2000 KW • AC&DC • GUARANTEED
SCHOONMAKER CO., INC.
50 CHURCH ST. NEW YORK 7, N. Y.
Plants: SAUSALITO(S.F.)CAL., JERSEY CITY, N.J.

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"Think SEARCHLIGHT FIRST"

Rotary Dryers—4½' x 30', 5 x 30, 5½ x 40, 6 x 60 & 11 x 75'.
Tube & Ball Mills—5' x 22'— 5½' x 20'—8' x 22'. 4½' x 40'—7' x 120' & New 6½ x 158' Kilns.
Oliver filters 12 x 10, 14 x 18 & 10 x 8.
Jaw Crushers—From 10" x 16" up to 40" x 48".
Crushing Rolls—From 12" x 24" up to 54" x 24".
Sturtevant Rotary fine crushers—No. 0—No. 2—Ball Mills 7 x 5'—6 x 12 & 8 x 6.
Harding Mills—1—6' x 22', 5' x 22" & 8' x 48".
Ring Roll Mills—Sturtevant No. 1—No. 2 duplex.
5'—16' & 18' Hereschoff furnaces.
Gyratory crushers, No. 6 to No. 12.
222—322 Allis-Chalmers Hydrocone Crushers.
Screens—classifiers, thickeners, air separators & filters.
5'—6' & 7' dia. Rod Mills.
6'—10'—14'—16' McCully Superior gyratory crushers.
New Dryers—Kilns, Dust Collectors & Lime Hydrators.

W. P. Heinecken, Inc.
50 Broad Street, New York

LIQUIDATION!

25 Acres

ORE MILL EQUIPMENT

Franklin, N. J.

Partial Condensed Listing!

CRUSHERS

1—#8K Allis-Chalmers.
1—22"x14" Sturtevant Roll.
4—26"x15" Sturtevant Roll.
2—32"x36" Edison Rolls.
3—36"x36" Edison Rolls.

CLASSIFIERS

1—90' Dorr Bowl Rake Thickener.
1—24' Dorr Bowl with 8'x32' rake sect.
3—Dorr 8'x34", 3 deck, 2 section.
2—Pellet Classifiers.

SCREENS, VIBRATING

7—4'x5' Hummer, type V16, 32, & 68.
6—Hummer, type 400, 4'x8'.
11—Tyler Tyrock F300, 4'x10'.
6—4'x10' Selecto.
3—12KVA, 15 cycle MG Sets.

DRYERS

1—6'x41½" Dia. x 12' L. Link Belt, Roto Louvre Dryer with Machler oil heater.

PUMPS

10—Wilfley, 2" to 4".
9—3" Morris Manganese.
27—Addt'l. Pumps, Centrifugal, Triplex, Vacuum, & Sump, up to 5650 GPM.

CONVEYORS

29—SCREW, 6" to 24" D., 10' to 129' L.
29—BUCKET ELEVATORS, 25' to 100' high, bucket size from 6"x4" to 22"x19",
43—TROUGHING BELT, 14" to 36" wide, 22' to 260' lengths.
15—FLIGHT (SCRAPER), 24" to 36" wide, 25' to 171' lengths.
1—75', 16" Pan Conveyor.

FANS & BLOWERS

3—#3 Roots.
2—#3 Wilbraham Green.
29—American, Buffalo & Claridge, #'s 5, 6, 17, 21, 35, 60, 80 & 100.
1—Schneible, Multiple Wash Dust Collector.

AIR COMPRESSORS

1—12"x12" C. P., Class NSB. 392 ft.
1—17" & 10" x 12" C. P. Class OCB. 788'.
1—25" x 15¼"x18" 1-R-PRE-2 2056 ft. 3351P 440/2300V.

ELECTRIC MOTORS

800—½ to 700 HP. including Geared Head and Motorized Reducers to 50 HP.

MISCELLANEOUS

11—Scobey Samplers.
1—6' Oliver Drum Dryer.
1—6' Oliver Filter Table.
3—13½' x 8' Oliver Drum Filter.
28—Trane & Grinnell Unit Heaters.
24—Magnetic Separators.
69—Tanks including Cones, 3' up to 28' x 30'.
14—Feed Rolls up to 36"x36".
1—4'x8' Trommel Screen.
6—Ore Skips.
4—Man Cages.
1—Ross Feeder.
8—Automatic Weight Hoppers.
15—Bottom Dump Ore R. R. Cars.
15—I. R. & Sullivan 15 HP, 2 Drum Scraper Hoists.
2—1½ ton Atlas Locomotives.
15 Ton BROWNHOIST Steam Locomotive Crane.
150 H.P. VULCAN, Size No. 72, Single Drum Mine Hoist.

Detailed Inventory mailed upon Request
Phone, Wire, Write TODAY!

L. J. LAND, INC.

Liquidators

Sales office—Franklin, N.J.
Phone Franklinborough 8-4281
New York Office — 147 Grand Street
New York 13, N.Y.

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INDUSTRIAL RUBBER PRODUCTS FOR EVERY PURPOSE

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SUCTION HOSE
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LOW PRICES!

Immediate Deliveries

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Phone: Digby 9-3810

FOR SALE

FAIRBANKS-MORSE DIESEL ENGINES

Model 32 E 14—2 Cylinder 150 H.P. @ 300 R.P.M. Almost New — Price Cheap!! 2-Available.

Write For Full Specifications

GLOBE TRADING COMPANY
1815 Franklin St., Detroit 7, Mich.
Phone WO 18277

SINK FLOAT PLANT: Mobil 2-unit with two 7 ft. dia. HMS Separating Cones with screens, pumps, magnetic separators, densifiers, demagnetizing coils, piping, valves, framework, etc., with all control equipment.

SCREEN: Tyler Hummer type V-50, 4' x 5', double deck, fully enclosed, with Thermionic power converter. Guaranteed condition.

DENSIFIER: Wemco 48" x 27'3", double pitch, flared tank, 5 H.P. vari-drive motor. NEW, NEVER USED.

CLASSIFIERS: Akins 54", Wemco 78", single screw, New condition.

PULVERIZERS: Marcy 6' x 12', trunnion and bearing type, with 200 H.P., 440 volt motor, with stone or steel lining. Hardinge 5' x 22" Ball Mill complete with motor driven disc feeder, 30 H.P. motor and control.

KILNS: 2—Rotary 8' x 150', 9/16" shell, with coolers, etc. Excellent condition.

JAW CRUSHERS: Allis Chalmers 42" x 40", 48" x 36" and 36" x 24", with motors and drive. Rebuilt.

COMPRESSORS: 2—Ingersoll Rand PRE-2, 14 x 22 x 16, 264 H.P., 225 RPM. 2200 volt, synchronous motors. Chicago Pneumatic OCB, 1044 CFM, 200 H.P., 440 volt, 3 phase, 60 cycle.

BLAST HOLE DRILLS: Joy Champion electric. Also, Bucyrus Erie 42-T with 9" bits and tools, hydraulic jacks, diesel motor drive.

MINE HOISTS: Single and double drum 100 to 1500 H.P. with all electrical equipment. Complete specifications, drawings and photos available.

MINE HOIST SPECIAL: Nordberg 1200 H.P., 1400 FPM, one drum clutched, wraps 1100 ft. 1¾" rope, complete with motor and all auxiliary equipment; with or without 95 ft. head frame.

HOIST MOTORS:
300 H.P., 435 RPM. 600 H.P., 710 RPM.
400 H.P., 588 RPM. 1200 H.P., 444 RPM.
2200 volt, A.C., with controls

LOCOMOTIVE CRANE: Link Belt 25 ton capacity, standard gauge, gasoline powered, cast steel trucks, air brakes, with or without 1¼ yd. Williams clam shell bucket, thoroughly modern, excellent condition. Located Minnesota. For sale or rent.

OVERHEAD ELECTRIC TRAVELING CRANES: Whiting 8 ton, 54' span, 4 motor, clam shell bucket operating, 440 volt, 3 phase, 60 cycle. Several other cranes both AC and DC, various spans, 5 tons to 55 tons, 3 and 4 motor.

LOCOMOTIVES: 2—65 ton diesel electric, standard gauge, thoroughly modern, excellent condition. For sale or rent.

TRANSITE PIPE: 7000 ft. 10" and 14", Class 100, 150 and 200 (NEW).

We Buy and Sell Equipment Throughout North and Central America.

A. J. O'NEILL

Lansdowne, Pa.
Phila. Phones: MAdison 3-8300 — 3-9301

IF
there is anything
you want . . .

that other readers of this paper can supply

or—
something
you don't want

that other readers can use, advertise it in the

SEARCHLIGHT SECTION

SINCE 1898 DEPENDABLE RECONDITIONED MACHINERY

BATTERY LOCOMOTIVES

1—2-2½ ton Whitcomb, 24" gauge
1—2½ ton Jeffrey, 36" gauge
2—3½ ton Mancha, 18"-32" gauge; with 2 sets Edison batteries
1—3½ ton Atlas, 24" gauge
1—4 ton Westinghouse, 24" gauge
1—4 ton Ironton, 36" gauge
2—6 ton General Electric
1—6 ton Mancha Trackmaster, 24" gauge, with 2 sets Gould KMZ-21 batteries
2—7 ton General Electric, 36" gauge, permissible
1—7 ton Atlas, 36"-48" gauge
2—8 ton General Electric, 36" gauge
2—8 ton Goodman, 36" gauge
3—8 ton Ironton, 24"-48" gauge
4—10 ton Atlas, 36" gauge

TROLLEY LOCOMOTIVES

1—4½ ton Goodman, 36" gauge
1—6 ton Jeffrey, 36" gauge
2—6 ton Jeffrey, 42" gauge
1—6 ton Goodman, 36" gauge
1—6 ton Goodman, 42" gauge
1—8 ton Goodman, 42" gauge
2—10 ton Jeffrey, 42" gauge
1—13 ton Goodman, 42" gauge
1—13 ton Jeffrey, 42" gauge
3—15 ton Jeffrey, 42" gauge

FILTERS

1—3' x 3' Oliver drum filter
2—4' x 8' Eimco drum filter
1—6' x 2 disc Oliver leaf filter
1—6' x 3 disc American leaf filter
1—18" Morse round pattern filter press
1—36" Merrill triangular filter press
1—#12 Sweetland filter press

DIAPHRAGM PUMPS

1—2" New Morse Diaphragm Pumps
2—4" New Morse Diaphragm Pumps
1—2" Dorrco Duplex Pump
1—4" Dorrco Duplex Pump
1—4" Barnes Pump
2—4" Butchart Pumps
1—4" Dorrco Pressure Diaprogm Pump

HOISTS

1—10 HP Vulcan #0 Single Drum
1—15 HP Morse New Single Drum
1—20 HP H&B Single Drum
1—22 HP Vulcan Single Drum #1½
1—30 HP Vulcan Double Drum
1—30 HP Vulcan Single Drum
1—37 HP Single Drum
2—52 HP Vulcan #4½ Single Drum
1—50 HP Fairbanks-Morse Single Drum
1—60 HP Vulcan #23ELF Single Drum
4—100 HP Box Single Drum
1—112 HP Vulcan Single Drum
2—150 HP Vulcan Single Drum
1—275 HP Dillon-Box Single Drum
1—22 HP Vulcan #1½ Double Drum
1—60 HP Ottumwa Double Drum
1—150 HP Dowco Double Drum Hoist
1—40 HP American 3 Drum
1—60 HP Thomas 3 Drum
1—60 HP Lidgerwood
1—60 HP Clyde 3 Drum

CRUSHERS

4—2¼" x 3½" New Morse Lab Jaw Crushers
1—4" x 6" New Morse Lab Jaw Crushers
1—9" x 15" Wheeling Jaw Crusher
1—9" x 15" Farrell Jaw Crusher
1—9" x 24" Rogers Jaw Crusher
1—11" x 18" Universal Jaw Crusher
1—24" x 12" Farrell Jaw Crusher
1—10" x 16" Hercules Jaw Crusher
1—10" x 16" Universal #3M Jaw Crusher
1—20" x 18" Williams Hammermill

MUCKING MACHINES

2—Eimco model 21 loaders
4—Conway model 50A loaders
1—Conway model 80 loader

COMPRESSORS

1—44 CFM Ingersoll-Rand
2—88 CFM Ingersoll-Rand
1—179 CFM Ingersoll-Rand
1—360 CFM Gardner-Denver, model WBH, with 75 HP motor
1—447 CFM Ingersoll-Rand
1—637 CFM Sullivan
1—998 CFM Union
1—600 CFM Ingersoll-Rand
1—840 CFM Laidlow
1—1418 CFM Ingersoll-Rand

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1—105 CFM Worthington, gas engine driven
1—210 CFM Worthington, continental gas engine
1—230 CFM Gardner-Denver stationary, Buda gas engine
1—310 CFM Sullivan, Buda gas engine
1—310 CFM Gardner-Denver stationary, Buda gas engine

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1—4HC Ingersoll-Rand Air Hoist
1—Sullivan Model G-112, driven by 15 HP Wisconsin gas engine

SLUSHER HOISTS

1—7½ HP Sullivan 2 Drum Slusher
1—10 HP Sullivan 3 Drum Slusher
1—Sullivan 2 Drum Model HD-10-B, driven by 30 HP Continental gas engine

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1—4' x 3' Morse Ball Mill
2—6' x 48" Hardinge Conical Ball Mills
1—8' x 22" Hardinge Conical Pebble Mill
1—3' x 8' Marcy Rod Mill

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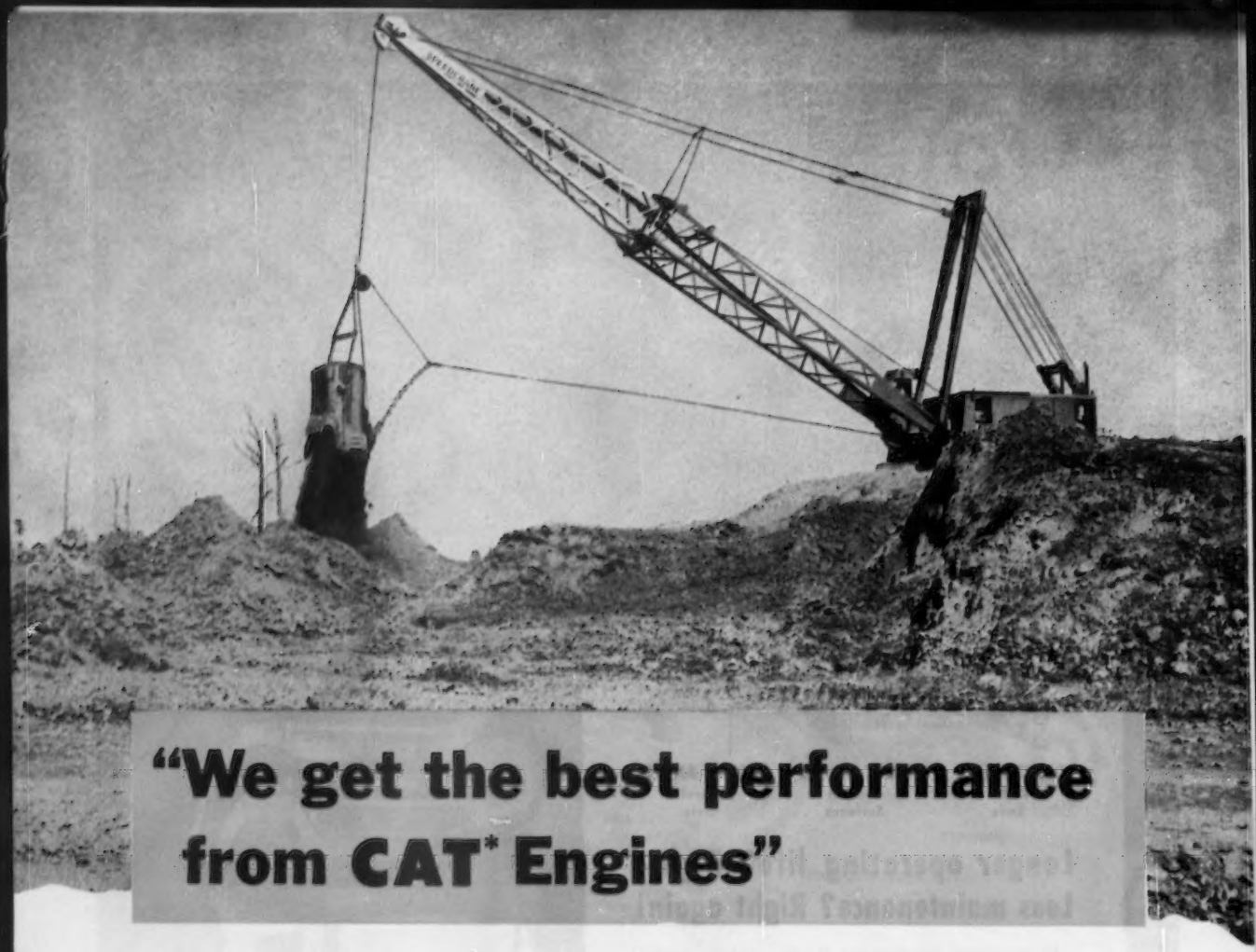

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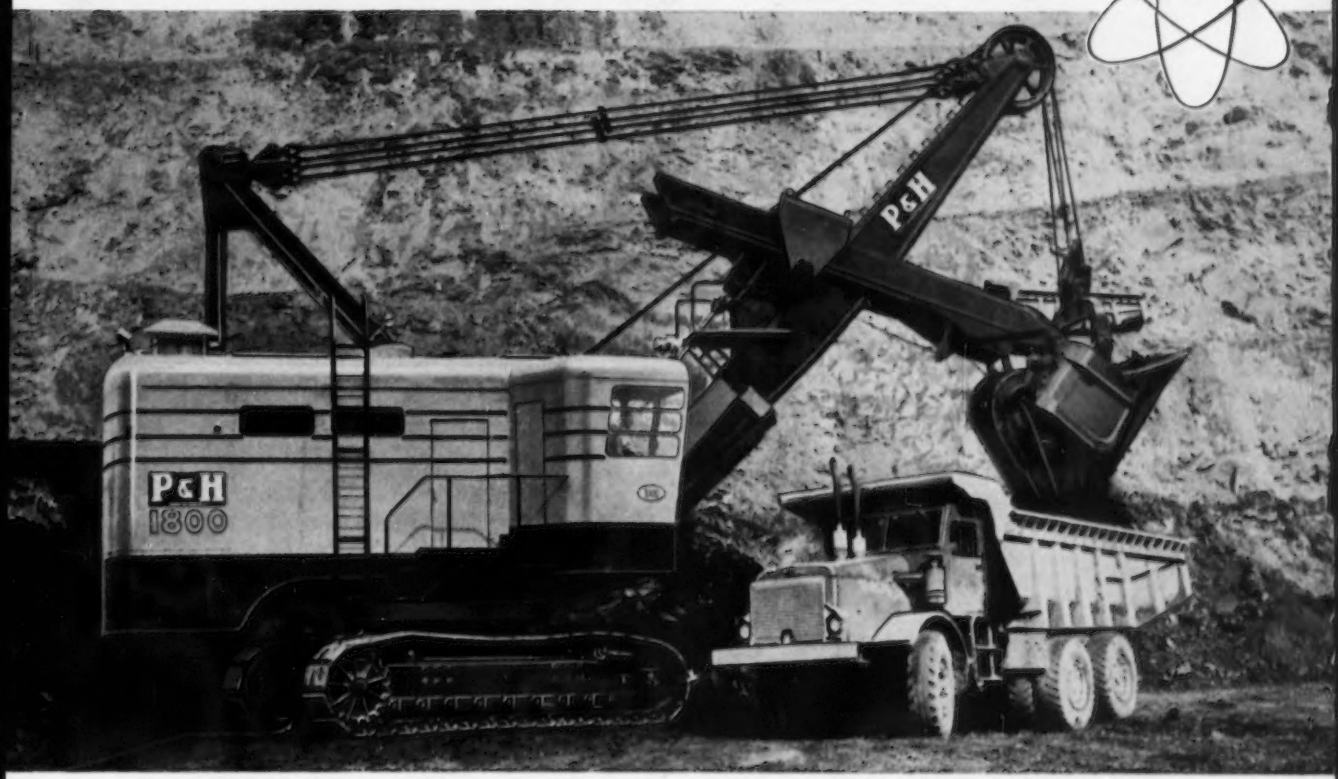

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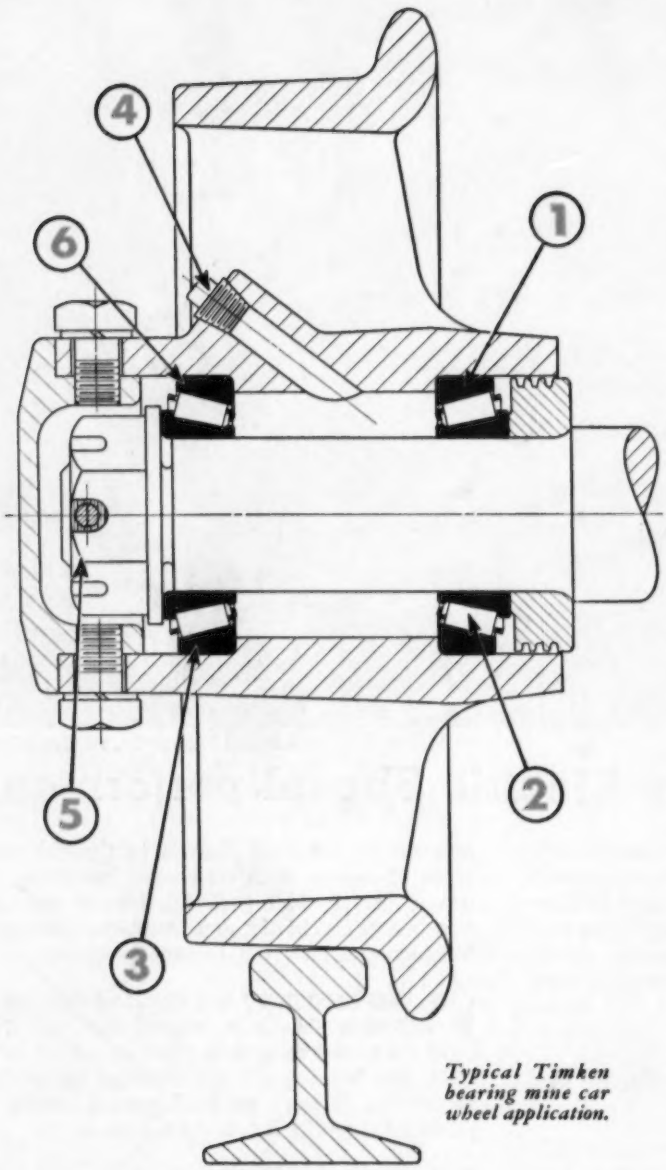

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